UTMOST

Undergraduate Teaching in Mathematics with Open Software and Textbooks
National Science Foundation CCLI Phase 2 Grant Proposal, Supplemental Questions
July 2010

Thank-you for the opportunity to respond to your questions and concerns raised by our proposal. We have organized our responses according to the original questions, with the exception that the "Additional Notes" are addressed at the end.

1. Engagement with Related Projects

NSF Question Text (in drafts only):

= Engagement with related projects =

* There are a number of projects related to the SAGE effort, e.g. the MAA's "MathDL Books Online" project led by Lang Moore, see award number: 0231083; the "Connexions" project at Rice University led by Rich Baruniak, see http://cnx.org/; and the "Holistic Numerical Methods Institute" led by Autar Kaw, see http://numericalmethods.eng.usf.edu/index.html. What possibilities do you see to engage in synergistic activities (e.g. in content, expertise, shared technology, etc) with these efforts?

RESPONSE:

David Farmer (AIM) and Rob Beezer have been pursuing more general projects around the creation and production of open textbooks, in any discipline. As part of this, they have had extensive discussions with Kathi Fletcher and Joel Thierstein of the Connexions project (resp. Project Manager, Executive Director). It would be a natural outcome to have Sage-enhanced textbooks designed to be compatible with their system (such as using their XML schema) and distributed with their Rhaptos software. So this potential is already being considered for Sage-enhanced textbooks in the broader context of generally producing open textbooks.

TODO: Jason, MathDL connections

The "Holistic Numerical Methods Institute" is new to the project's personnel, but it also looks like a good fit with Sage and related instructional materials. One of the textbooks we may convert is Steven Pav's *Numerical Analysis*, (reference [59] in original proposal), so numerical analysis is an area of the undergraduate curriculum we plan to examine in the course of this project.

2. Engagement with Other Institutions

NSF Question Text (in drafts only):

= Engagement w/other institutions =

* A number of reviewers wanted to see more information about implementation efforts at other schools. For example, "PIs could have strengthened the proposal by addressing institutionalization efforts at participating colleges and universities if implementation is successful" and "I would have rated this proposal higher if it had included commitments from the seven additional institutions." In sections 5.3.1 and 5.3.2, the proposal narrative does set out a useful description of the activities and selection criteria. But beyond the three institutions with whom you have already secured commitments to test out the implementation of SAGE, what other institutions have you contacted and who will you work with at each?

* How do you plan to ensure that a diverse set of institutions will be involved? Are some of these HBCUs or MSIs? What about two-year colleges? What timetable for bringing these institutions on board do you envision? Please supply appropriate letters of interest, if not commitment to participate.

RESPONSE:

As part of reducing our overall budget, we have reduced the number of test sites from ten to eight, and plan to work with three schools in the 2011-12 academic year and five in the 2012-13 academic year. We have commitments from three schools for the first group. We have planned to have the flexibility of selecting the other schools in Spring 2011, when we have a more precise estimate of which converted textbooks will be available for the schools to use.

Schools already committed include California State University, Dominguez Hills, which we selected in large part due to its diverse student population. CSUDH is listed as a Minority Serving Institution (MSI) [4], with current minority enrollment (December 2009) totaling 70.8% of undergraduate enrollment [1]. Additionally, CSUDH is the lead institution on a 5-year Department of Education

Title V cooperative grant for their "Gateways Math-Science Project," designed to support and encourage Hispanic students [2]. Finally, CSUDH actively participates in the Louis Stokes Alliance for Minority Participation program, designed to broaden partipation in STEM disciplines [3]. This program is a statewide initiative with funding from the National Science Foundation (HRD-0802628). UTMOST plans to have similar success in recruiting an HBCU as part of our second group.

With very limited advertising in Fall 2009, we received additional expressions of interest (as emails) from the following six faculty and schools:

- Prof. Dan Drake, Korea Advanced Institute of Science and Technology
- Prof. Dana Ernst, Plymouth Sate University (Maine)
- Prof. Edgar Jasso, North Seattle Community College
- Prof. David Joyner, U.S. Military Academy
- Prof. Erin Martin, Westminster College (Missouri)
- Prof. Jared Schlieper, Armstrong Atlantic State University (Georgia)

TODO: Review NSCC info below. Attach letter.
We plan to advertise more widely, and directly solicit HBCU and MSI schools as we carefully select additional institutions to participate as test sites. As part of this response we have invited North Seattle Community College to be part of our second group of test sites. A letter committing to their involvement is attached. This demonstrates interest from two-year institutions, and further demonstrates UTMOST's commitment to involving a broad range of institutions and students. We fully intend to keep this commitment when we select the remaining four schools for our second group.

TODO: Jason, Nate Dean, NAM potential for HBCU (here or above somewhere)

TODO: ADDRESS INSTITUTIONALIZATION AND SHORT-TERM COMMITMENT - could use help here

3. Project Details and Management

NSF Question Text (in drafts only):

= Project details and management =

More than one reviewer expressed concern that the proposal had outlined perhaps an overly ambitious agenda: "However, the breadth of the proposed activities, in the absence of additional supporting detail for how the activities will be accomplished, raises some concerns." Or, "I am concerned about the many initiatives the project proposes."

* What does the team envision as the relative balance of effort among the different implementation components laid out in section 5?

* What is the scope and nature of the production of non-text-based materials? How comprehensive a set of materials does the project envision, e.g. are these suites of general visualizations that can be used in a wide variety of settings? What other types of materials are planned?

* Please clarify the roles and responsibilities of project team members as they are connected to the primary goals, objectives, and tasks of the project. It would also help greatly if these activities are mapped to a timeline.

* What types of members of the Editorial Board do you envision? What expertise and experience do you see are appropriate? Who has already agreed to serve, and how will you recruit others?

RESPONSE:

3.1. **Breadth of activities.** In response to concerns that our plans are overly ambitious and in concert with the requested budget reduction we have

- Reduced the number of test sites from ten to eight.
- Eliminated trials of physical servers at test sites.
- TODO: More? Others?

3.2. **Scope of interacts, etc.**
TODO: Cite full-page timeline in appendix
TODO: Waiting on timeline info before tackling this. Help from Jason.

3.3. **Team members' responsibilities.** The table below clarifies the team members' primary and secondary responsibilities. Section 9 contains a more detailed timeline to further describe the relationship between the project's activities, personnel and schedule.

Team Member Roles		
Personnel	Primary	Secondary
AIM	AIM Editorial Board (Dissemination)	Grant Administration
Beezer	Textbook Conversions	Notebook Support for Textbooks Sage Library Code Non-Text Materials Liaison (2)
Grout	Notebook Improvements	Textbook Conversions Sage Library Code Non-Text Materials Liaison (2)
Haasi	Evaluation	
Judson	Evaluation	Abstract Algebra Textbook Liaison (2)
Kedlaya		Liaison (1)
Stein	Notebook Design Notebook Usability Notebook Scalability	Number Theory Textbook Sage Library Code Non-Text Materials Liaison (1)

3.4. **AIM Editorial Board.**
TODO: DAVID, GIVE SOME NAMES OF PEOPLE (TALKED TO, COMMITTED, SHOWN INTEREST, ETC.). ONE OR TWO THAT HAVE COMMITTED. * KEN RIBET

4. Evaluation

NSF Question Text (in drafts only):

= Evaluation =

In general the panelists saw the proposed evaluation efforts as solid, however questions remain. For example: "The PIs present data to support the fact that large numbers of people are creating accounts online, but details to indicate how they are using the accounts and an assessment of the impact of prior efforts on student learning would have strengthened the proposal." And "There was some thought that more details of the assessment of student learning from the Phase 1 activities should have been included in the current Phase 2 proposal."

* The types of questions posed at the beginning of section 6 are fine, but can these be "sharpened" to go beyond just descriptive (What and How?) towards the explanatory (Why?) Please provide some examples of these more probing questions the project team would ask and how you might collect data or otherwise make observations that would help answer these kinds of questions.

* One direction of this kind of inquiry was suggested by a panel member who asked about connecting the evaluation and assessment work to research efforts about the use of dynamic textbooks. Is this reasonable and how might the evaluation group go about investigating this?

* One of the important benefits of the Sagebooks environment is that materials may not only be reused, but also revised and adapted by others. From that starting point, are there ways the project can observe user behavior more deeply? For example, can modifications be tracked, contributions recorded, etc. What about capturing and analyzing network interactions among participants? What does the social graph look like and how does it change and why? Is growth in student understanding somehow observable through changes in how students use the materials and interact with the faculty and/or their peers?

RESPONSE:

4.1. **Previous assesment (Phase 1 style).** TODO: William, Jason, Rob. Poll sage lists?
TODO: DATA: HARALD SCHILLY'S SURVEY MAA PREP WORKSHOP WILLIAM'S TEACHING EVALUATIONS * SAGE CLASS * NUMBER THEORY CLASS ROB AND JASON'S EVALUATIONS QUERY SAGE LISTS FOR EVALUATIONS

MENTION WHAT WE HAVE AND WHAT WE ARE LEARNING. SOME EVIDENCE THAT WE ARE DOING THE SURVEYS AND LEARNING?

4.2. **Sharpened questions.** The emphasis in the evaluation is on faculty change and less on student outcomes. Accordingly, we will focus on the benefits of using open source texts and tools for instructors knowledge and practices in teaching mathematics. We will study these issues by focusing on the activities, factors, and challenges that instructors face and deal with while adopting and using the open tools and materials. We will explore how and to what extent instructors who attend the workshops proceed with the implementation of the tools and material in their mathematics classes. All these research questions are importantly intertwined with questions of "How?" that help to understand the benefits and challenges of use of the open source texts and tools as well as the changes in the instructors teaching practices and in their students learning.

More detailed questions will be used in the survey measures and interviews. In the pre-survey, for example, questions of the type "Why?" will consist of inquiries such as: Why do instructors attend the workshop; what kinds of knowledge and expectations do they have concerning the open source texts and tools; and in what way do they think that using open sources and materials will help their teaching of mathematics? In the follow-up survey, instructors reports, and interviews, we will ask about the instructors experiences and benefits in using the open source texts and tools in their own classrooms. Accordingly, we will ask the instructors to explain possible reasons for their successes or failures in using the tools and sources. As well, both in the SALG instrument and in the focus-group interviews, we will explore students experiences, obstacles and gains from using the sources and tools in learning mathematics. In addition to asking about student learning gains, other items will probe aspects of students experiences in their mathematics classes and how these did or did not help their learning. These data will also answer questions about why or why not did students find the tools and material helpful for their learning.

4.3. **Dynamic textbooks.** The use of dynamic textbooks provides a very interesting area for multiple research questions on instruction and practices. Within the rather limited resources, we will be able to capture only a snapshot of these various interesting issues. However, as part of the project we will explore all the relevant literature related to these issues and also possibilities for more thorough later investigation about the use of dynamic textbooks.

4.4. **Observing network interactions.** Research questions related to detailed study of modifications in instructional practices and changes in instructors and students behavior are definitely interesting and worth exploring. We will explore and use existing research and literature on these issues. Instructors adoption and use of the Sage material and tools for their own teaching will be studied by follow-up surveys, interviews, and instructors reports after their one-year implementation. The project team will also observe the instructors mathematics classes and gather notes during the site visits to the institutions. In addition to the notes from the site visits and the instructors reports, questions about changes both in instructors and students activities and collaboration will be included in the follow-up surveys, interviews, and students survey. By using Mercurial, a distributed source control management tool, it is also possible to track students modifications to the material that are contributed back to open-source textbooks. In turn, observing student use (or misuse) of material in a Sage worksheet represents one way for an instructor to learn more about their students behavior. However, detailed observations and analyses of network interactions and behavioral changes conducted by the team are beyond the scope of the present evaluation study.

5. Technology

NSF Question Text (in drafts only):

= Technology issues =

* You'll have seen that several reviewers commented on wanting to see more detail regarding the Sage server infrastructure, both current and projected. For example, "A concern would be the actual purpose of the Sage servers and their on-site implementation. More information should be given about what impact this will have on actual usage of the implementation." Or "The capabilities of the Sage server were unclear—is the current software sufficient to meet the needs of a moderate to large campus using these on-line texts?" Please clarify these points.

* What statistics are available regarding installations of SAGE? Can the "nature" of such installations be tracked? I am thinking here of things like: locations, growth over time, distribution over time, the usage data at each installation, etc.?

* What is the cost for a site to set up a SAGE server to provide access locally? (Note: the implementation cost is related to questions that follow regarding broader impact and affordability.)

RESPONSE:

TODO: WILLIAM

VISITORS TO WEBSITE NUMBERS OF DOWNLOADS VOLUNTARY LIST OF DEPLOYED SERVERS

TODO: (William) Discuss decision to scale notebook for sagenb.org type instances, while acknowledging that it won't rival Google-esque instances.

5.1. **Data on usage.** TODO: Server stats, notebook installs, etc.

6. Dissemination and Impact

NSF Question Text (in drafts only):

= Dissemination/Impact =

* How will the system to allow textbooks to be converted to this on-line format be assessed? Will the larger-scale adoption of texts developed in this context be assessed (as compared with other similar texts, etc.)? Please respond.

* The panel also sought to understand whether "the use of AIM as an 'established authority' to vet the texts will be sufficient to motivate large-scale adoption." Please respond.

* There was also concern that: "dissemination appears to be largely focused on colleges and universities with more resources." However, reviewers did recognize that the project has an intent to engage two-year colleges and under resourced institutions among the test sites. Please clarify how the dissemination plan expects to undertake reaching a broad audience of potential users.

* Some panelists also wondered about the appeal of the open-source texts beyond the existing community. For example, in the panel summary reviewers wrote: "A final question raising concerns about broader impact was whether the open-source textbooks being developed would be (or even could be) appealing by those outside of the existing Sage community." While NSF does share enthusiasm for open-source approaches, the concern raised by reviewers is legitimate. What are the potential barriers to broader adoption that the project has identified and how does it propose to address these?

RESPONSE:

TODO: Mostly this was assigned to David, but I think some of this is a bit more general. Are assessment questions right for the evaluation specialists? Tom, M-L?

7. Budget

NSF Question Text (in drafts only):

= Budget =

* One panelist had "major reservations" that release-time was not clearly budgeted for the teacher-authors who will implement, develop and assess the modules of the online interactive texts. Please clarify this question.

* There was confusion regarding how provisioning the remote use of Sage would be handled. Is this through an in-kind contribution of server time and maintenance at the University of Washington, or is the intent to request grant funds to install new servers at participating institutions?

* The above question is related to concern that broad adoption is dependent on the capacity for adopting institutions to host an installation of Sage locally and bear those long-term costs, or whether sufficient capacity exists centrally to allow many remote users spread across participating institutions. If more server capacity must be implemented (and this could take the form of either central improvements or greater resources brought to bear at each site), are there adjustments to the originally proposed technology expenditures that are better spent in this way, then on their initially proposed purposes? Please respond.

RESPONSE:

7.1. **Support for test-site preparation.** Our revised budget includes $38,000 in stipends for test sites. These monies are intended for summer work by faculty to familiarize themselves with Sage and open textbooks as they prepare their courses for new materials, tools, and approaches. We have not encumbered these stipends with exact stipulations on their use, in hopes that each institution will have the flexibility to use them most effectively. Faculty using Sage would certainly be even more successful if we were able to provide release-units contemporaneously. However, given the necessity of reducing the project's overall budget, this seems too great a luxury.

7.2. **Server placement and maintenance.**
TODO: William - accurate below, given context above?
As described above, we have removed the purchase and placement of physical servers at two test sites, partly to reduce the range of the project's initatives and partly to reduce the overall budget. We will instead concentrate on the global server, `sagenb.org`, located at University of Washington. This server was purchased with a National Science Foundation grant, and will be maintained by the University of Washington for the duration of the UTMOST project.

7.3. **Reallocated technology expenditures.**
TODO: does this need a central/distributed discussion again?
Our budget allocates $2,000 annually for system administration in the two years when test sites will be actively using `sagenb.org`. This was previously meant to support the physical servers placed at test sites, but will now be used to insure availabilty and responsiveness of `sagenb.org` for the purposes of the project.

Our budget reductions have been spread thoughtfully throughout all areas. One of the few places with no reduction is funds to pay for student and consultant work on Sage infrastructure. With a greater focus by UTMOST on central servers such as `sagenb.org` we felt is was important to continue to dedicate substantial funds to improvements in the scalability of notebook servers. So with budget reductions elsewhere, this expense is now proportionately greater.

8. Additional Notes

NSF Question Text (in drafts only):
= Additional Notes =

* A couple of the institutions that are part of this collaborative submission indicated on their respective cover sheets that Human Subjects Approval was in the process of being sought. We will need to receive the appropriate documentation that this approval has been granted by the relevant Institutional Review Boards. The best thing to do here is to have that signed approval (on the school's letterhead) scanned as a PDF and e-mailed directly to me.

* Our overall CCLI budget for math remains tight so we are trying to support as many projects as we can. Therefore we would like to see if you could explore some potential cost savings in your budget. We think we can get up to a figure of $525K. Where you would find adjustments to make would be entirely up to you and your team. If this is doable and I hope it is, you'll need to submit a revised budget and include a "budget impact statement" that describes what if any impact the reduction would have on the scope of the project. I realize that with a collaborative submission, you will need to work with your collaborators. But it would be up to you though as to where you would look for the savings. It may mean that all of the partners will need to submit revised budgets, but it would be fine if you chose to do this only with a subset of your group. Again, it is your call here.

RESPONSE:

8.1. **Human subject approval.**
TODO: Report on progress here at last possible moment.
Waiting on Tom, M-L once completed.

8.2. **Budget impact statement.** We have been asked to reduce the project budget by 12.5%. The following explanations (with precise reductions) summarize the hard choices we have made through a conscientious examination of the project's propossed activities and the necessity of each expense. Dollar figures in parentheses at each item include relevant indirect costs, and within a few dollars, total to the $75,000 reduction achieved on budget forms. Other dollar figures are exclusive of indirect costs.

Summer Salary, Stein ($21,452): Stein's summer participation has been reduced by a single month. This will lessen the amount of work done to design, lead and implement improvements in the notebook server (`sagenb.org`) and contributions of non-text materials to Sage. Funds for student and developer projects have not been reduced, so much of the server improvements will be accomplished as originally planned.

Summer Salary, Beezer ($14,960): Beezer's summer participation has been reduced by a single month. This will lessen the number of textbooks that will be Sage-enhanced and the contributions of code and non-text materials to the Sage library, but should not affect the creation of a system for converting textbooks.

Test Sites: As discussed elsewhere, we have reduced the number of test sites from five annually to four.

- **Stipends ($12,600):** Reducing the number of test sites gives a 20% reduction in stipends.
- **Servers ($3,780):** As discussed above, we have eliminated our placement of two $1,500 experimental servers at test sites.
- **Evaluation ($3,635):** With a reduction in the number of test sites, certain variable costs have been proportionately reduced and some adjustments will be made in reporting. Given the overall positive reviews of the evaluation portion of our proposal, and significant fixed costs (e.g. survey and interview design), we have greatly limited the reductions here (to about 4.4%).

AIM Open Textbook Initiative ($6,300): Funds for dissemination as part of the open textbook inititative at AIM have been reduced by $5,000 over the entire life of project, which will partly limit what can be done in this area.

Sage Days ($5,670): Since submitting our original proposal, the Sage project has received a grant from National Science Foundation COMPMATH program (with Stein as co-PI), to fund a series of Sage Days workshops. One workshop is devoted to the Sage Notebook web interface, which is a key feature for education and delivering Sage-enhanced textbooks, and overall is critical to the objectives of this grant. By combining one of the workshops for this grant with the COMPMATH-supported workshop on the notebook, we have reduced our funding request for one workshop by half. This should have no negative impact on the quality of the workshop, and quite possibly there will be greatly increased synergy between key notebook developers and a group of educators that rely heavily on the notebook in their teaching.

Travel ($4,725): Travel funds have been reduced by $3,750 per person over the entire life of the project, roughly eliminating three opportunities for close collaboration or conference participation.

Computers ($1,872): Since submitting our proposal, Grout has (unexpectedly) been provided a new laptop by his home institution. With a better estimate of the total cost, the request for a powerful desktop computer to use for Beezer's textbook conversions and Sage development work has increased by $114.

UTMOST Project Timeline

Personnel	Summer 2010	AY 2010-11	Summer 2011	AY 2011-12	Summer 2012	AY 2012-13	Summer 2013
All		Site Selection	Sage Days		Sage Days		
AIM		Consitute Editorial Boad, begin to design requirements	Release textbook requirements	Evaluate first group of textbooks	Create website with requirements and approved books	Evaluate second group of textbooks	
Beezer	Textbook Conversion System	Sabbatical Leave Textbook Content Sage Library	Textbook Conversion System	Liaison, Reed		Liaison	
Grout				Liaison		Liaison	
Hassi		Pre-survey data + analysis (1.workshop) Post-survey/interview instrument	1. Workshop observation Post-survey/interview data	Site visit and observations Follow-up survey/student data Interview protocols (follow-up interviews, reports) Data analysis (post-survey, site notes) + report Pre-survey data + analysis (2. workshop)	2. Workshop observation Post-survey/interview data 1. Year data analysis (follow-up, reports, student data, site notes) Teacher interviews (sites) + analysis	1. - 2. Year data analysis (follow-up, reports, student data, site notes) Follow-up survey/student data Teacher interviews (sites) + analysis	2. Year data analysis (follow-up, reports, interviews, student data, site notes) Final report
Judson	Textbook preparation (Abstract algebra)	Textbook preparation and conversion	Textbook conversion	Liaison, SFASU	Evaluation	Evaluation Liaison	Evaluation
Kedlaya				Liaison, CSUDH			
Stein						Liaison, NSCC	

References

[1] CSUDH "Student Demographics" report, December, 2009, http://www.csudh.edu/univadv/documents/publications/csudh_student_demographics_200912.pdf

[2] CSUDH Gateways Math-Science Project, http://www.csudh.edu/classTitleVGateways/

[3] CSUDH Louis Stokes Alliance for Minority Participation, http://www.nbs.csudh.edu/biology/lsamp/index.html

[4] United States Department of Education Accredited Postsecondary Minority Institutions, Spring 2007, http://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst-list-tab.html