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.

TODO: Drop draft footer on final.

1. Engagement with Related Projects

David Farmer (AIM Director of Programming) and Rob Beezer (PI) 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. One sentence.

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

As part of reducing our overall budget, we have reduced the number of test sites from ten to eight, and plan to work with four schools in the 2011-12 academic year and four 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. So soliciting three commitments for our original proposal was a conscious decision to demonstrate interest, and not a failure to arrange all of the test sites in advance.

TODO: Previous sentence too strident, inappropriate?

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) [5], with current minority enrollment (December 2009) totaling 70.8% of undergraduate enrollment [2]. 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 [3]. Finally, CSUDH actively participates in the Louis Stokes Alliance for Minority Participation program, designed to broaden participation in STEM disciplines [4]. 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 (New Hampshire)
- 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 for currency. Attach letter if it exists.

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 supplemental response we have invited North Seattle Community College to be part of our second group of test sites and they quickly and enthusiastically agreed. 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: Review Nate Dean contact for currency. Jason?

Prof. Nate Dean (Texas State University) is President of the National Association of Mathematicians, whose main objectives include "the promotion of excellence in the mathematical sciences and the promotion of the mathematical development of underrepresented American minorities" [7]. Professor Dean is familiar with Sage and we have begun discussions seeking his assistance with identifying possible HBCU that could be test sites. Prof. Kent Morrison (AIM, Cal Poly San Luis Obispo) has worked closely with faculty from several HBCU and Sage at the AIM Workshop, "Research experiences for undergraduate faculty" [1] and is involved with this proposal through the AIM Editorial Board, so he will be another valuable and knowledgeable contact when we select the second group of test sites.

TODO: Review new paragraph below on "institutionalization."

We will provide extensive support to our test site faculty, in part through each project member serving individually as a liaison with just one school at a time and also through participation in Sage Days workshops. At the conclusion of the project, these faculty should be well-qualified to assist their departmental colleagues. After our test site faculty use Sage, and a Sage-enhanced textbook for the first time, it should be an easy matter to continue. The ongoing costs are negligible and Sage will continue to provide support forums, the `sagenb.org` server and new releases of the software and free textbooks through its extensive community and continued success attracting grant support from a variety of sources. Test sites already committed have expressed great enthusiasm for participating with the broader Sage project for the long-term. So we believe that the efforts we initiate will be well-placed to continue.

3. Project Details and Management

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.
- Eliminated providing support and documentation for server administration (Section 8.3).
- Provided realistic estimates of interacts and subject guides to be produced (Section 5.2).

TODO: Review sentence below for emphatic statement that we are correctly ambitious.

We have created a short table of key roles and responsibilities (below), and updated our timeline (an internal document we did not include in the original proposal), included in Section 9. Scaling back or eliminating several activities, and carefully documenting our modified plans, has made us confident that we can achieve the project's goals with the time and resources requested.

TODO: More examples of scaling back? Beezer: Re-read original proposal.

3.2. **Scope of interacts, etc.** In addition to the textbooks we will enhance, we plan to produce a number of subject-specific materials that can be used in a wide variety of settings, e.g., as classroom aids, lab demonstrations, homework investigations, homework help, etc. These materials will range from Sage worksheet tutorials for major topics to self-contained "interacts" that explore a specific aspect of a problem using buttons, sliders, and other controls. We plan to create an easily-searchable repository of at least 100 high-quality, reviewed interacts which will be included in every copy of

Sage. Examples of some interacts that faculty have already been using in a variety of settings are here: `http://wiki.sagemath.org/interact/`. For calculus 1, calculus 2, multivariable calculus, and differential equations, we (or faculty at test sites) will also create short tutorials that address major topics in each course. As time allows, we may also create short tutorials for other courses such as statistics or math modeling. A few examples of worksheets that explore topics or guide student investigations in the classroom, in the computer lab, or as part of homework assignments are:

- Optimization (multivariable calculus): `http://sage.cs.drake.edu/home/pub/33/`
- Changing bases (linear algebra): `http://sagenb.org/home/pub/2225/`
- Approximating integrals (calculus 1, 2): `http://sagenb.org/home/pub/1847/`
- Approximating polynomials (numerical analysis): `http://sage.cs.drake.edu/home/pub/2/`

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 Abstract Algebra Linear Algebra Number Theory	Linear Algebra Textbook Notebook Support for Textbooks Sage Library Code Interacts, Subject Guides Test Site Liaison (2 sites) Organize Sage Days
Grout	Notebook Improvements Features Usability Textbook Conversion Interact Search	Sage Library Code Interacts, Subject Guides Test Site Liaison (2 sites) Organize Sage Days
Hassi	Evaluation Specialist	
Judson	Evaluation Liaison	Abstract Algebra Textbook Test Site Liaison (2 sites) Organize Sage Days
Kedlaya		Test Site Liaison (1 site) Organize Sage Days
Stein	Notebook Improvements Design Usability Scalability Textbook Support	Number Theory Textbook Sage Library Code Interacts, Subject Guides Test Site Liaison (1 site) Organize Sage Days

3.4. **AIM Editorial Board.** All members will be faculty actively engaged in teaching undergraduate math classes and who have had experience using or trying to use mathematical software in the classroom. Members will include people with experience writing textbooks for a commercial publisher, and people with experience editing a mathematics publication such as one of the MAA publications.

Faculty who have expressed an interest in serving include:

- Prof. David Austin, Grand Valley State University
  Regular Contributor, American Mathematical Society Feature Column
  Organizer, Sage Days 9, August 2008
  TODO: Should we include Austin's Sage connection?
- Prof. Fernando Gouvêa, Colby College
  Editor, Mathematical Association of America Focus (newsmagazine)
  Editor, Mathematical Association of America Reviews (online book reviews)
- Prof. George Jennings, California State University, Dominguez Hills
  Content Review Panelist, California State Board of Education, 2000, 2005, and 2007
  Instructional Materials Advisory Panelist, California State Board of Education, 1998
- Prof. Kent Morrison, Cal Poly, San Luis Obispo
  Textbook Author, Partial Differential Equations
  AIM Visiting Researcher
  Convener, proposed Editorial Board
- Prof. Frank Sottile, Texas A&M University
  Associate Editor, SIAM Journal on Discrete Mathematics

4. Evaluation

todoReview next subsection. I've made up Stein's contribution, asked Jason to rewrite with more of a faculty perspective.

4.1. **Previous assessment.** There has been little systematic evaluation of the effect of using Sage on teaching in undergraduate courses. However, there is evidence that faculty interest in using Sage is definitely increasing. A professional development workshop sponsored by the Mathematical Association of America, devoted to using Sage in undergraduate teaching, had more interest than the enrollment limit allowed. The Short Course at this summer's MAA MathFest will explain the use of Sage in algebra and combinatorics. This course is notable as none of the five presenters is a regular participant in the Sage development community. The Sage forum devoted exclusively to educational uses of Sage, `sage-edu`, now has 326 members.

Three of the project PI's have used Sage extensively in their courses and found it very beneficial for their teaching.

- Stein has used Sage to illustrate ideas in number theory, in concert with his textbook *Elementary Number Theory*. Additionally, he has taught courses about Sage itself, introducing students to mathematical experiments and explorations using Sage. Stein's students have noted that learning the basics of the Python programming language have been helpful with their other science and engineering courses where Python is being used more frequently.
- Grout says (from memory, as I don't have the evaluations handy): some students really appreciated the software. One student found it difficult while we used it in class, but later specifically came to my office and told me that she was excited about the software and had done her final math ed teaching project on using Sage in teaching mathematics. Lots of students have used Sage in their homework explorations and assignments in math modeling and numerical analysis. Some students complained that we didn't use Mathematica (which they knew from other courses). Most of the time, after carrying out a project in class, students specifically ask for access to the worksheets used.
- Beezer has used Sage in several courses, but tightly integrated it into three semesters of abstract algebra, along with using Judson's free *Abstract Algebra: Theory and Applications*. The ability to explore complicated permutation groups, or non-trivial field extensions, made the course much richer, and student evaluations reflected the belief that they had indeed seen and learned things that would not have been possible in a traditional course. Other than

possibly Magma (which is prohibitively expensive) no other software could have provided this experience.

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

5.1. **Sage server infrastructure.** Whenever Sage is used via the notebook interface in a web browser, it communicates with the server functions of Sage (included in every copy), which may well be installed and running on the same computer as the notebook. More typically in an educational

setting, the server software runs on a separate machine, accessible over the network. Properly configured, and on appropriate hardware, the server can support many users. The best example is the `sagenb.org` server, which has well over 30,000 accounts and has supported many courses (such as several for each PI). With minimal hardware and a stock installation, a server can comfortably service small groups, such as a single course. One of the principal activities of this project is to understand the use of the notebook server in undergraduate mathematics courses and make the necessary improvements to reliably support more users concurrently.

A notebook server is more complicated than a typical web server, as it responds to regular interactions with each user, with later queries (calculations) relying on previous results (other calculations). And it is easy for a user to ask for an incredibly intensive computation (intentionally, or not). With test sites using `sagenb.org`, or dedicated instances housed physically at the University of Washington, improvements to the notebook can be studied carefully and further work on design and configuration will be suggested. In order to limit the scope of our activities, we have eliminated placing and administering physical servers at test sites as part of this study.

TODO: Review some additions to next two paragraphs with William contributions

Our proposal stated the goal that improvements will allow the notebook to "robustly handle up to 250 simultaneous users viewing worksheets and doing typical computations for an undergraduate course when running on a single high-end server." The only area of our budget that we did not reduce was programming support for the notebook, so we remain committed to this goal, and have focused our attention here by eliminating funding for local server support. We will do this through systematic benchmarking and subsequently rewriting key parts of the Sage notebook server software.

In principle, the Sage server could scale to serve arbitrarily many users, just as Google scales its services for search, mail, maps and discussions. This project will help the Sage server progress in that direction. We emphasize that solving these scalability problems is a difficult challenge, but we believe we have the resources, personnel and community to achieve success in greatly improving network access to Sage servers.

5.2. **Sage usage.** With no salespeople, no invoices and having granted a worldwide free license, it is very difficult to track the use of Sage. Examples of twenty-four notebook server installations can be found on the Sage wiki [9] but these are self-reported by people who also happen to frequent the Sage discussion groups. There surely are more that have not been reported. So other measures of Sage use and acceptance can be used as proxies. The Sage support forum has 1,796 members, the development forum has 1,224 members. Actual contributors to the development process (code, build system, documentation) number roughly 200, from around the world. The Sage website has 80,000 visitors a month, with at least 6,000 downloads a month.

5.3. **Sage server costs.** As suggested above, a Sage server can be run on commodity hardware, or on high-end servers. A Sage server for a single user can be run on a $250 netbook. `sagenb.org` is just one of four servers (each with 24 cores) in a roughly $100,000 installation, so the one server cost roughly $25,000. So the cost varies depending on the situation and expected use. In practice, a less powerful device (like a netbook) is going to have a better experience connecting over the network to a more powerful server. But a reasonably priced laptop can provide an excellent dedicated session for a single user. However, in an educational setting, the advantages of centralized administration and platform-independence of a large server, such as `sagenb.org`, have led us to concentrate on this scenario for our test site partners in this project.

6. Dissemination and Impact

6.1. **Textbook conversion assessment.** The conversion of textbook to an online format is a technical issue, and the conversion is considered successful if the textbook becomes available in an online format suitable for classroom use. This includes high-quality typesetting, ease of navigation,

etc. This will be judged by the students and instructors using the book, and will be part of the planned evaluation.

6.2. **AIM as an established authority.** At present there exist many websites listing open or free textbooks, but none (to our knowledge) which provide a detailed evaluation and approval process for those textbooks. AIM can provide objective and subjective criteria to evaluate free textbooks, based on the suitability of those books for specific courses. This will make it possible for instructors to more easily determine if there is a free textbook they could consider for a class.

TODO: Review PIRG campaign info and transition into AIM going further.

The "Affordable Textbook Campaign" of the Student Public Interest Research Group [6] considers free textbooks a strategic element of their national advocacy effort. David Farmer and Rob Beezer have a close working relationship with the director of this campaign, Textbook Advocate Nicole Allen. This group has:

- Attracted more than 2,000 faculty to sign their "Statement of Intent" to consider open textbooks in their textbook adoption decisions.
- Trained student members of campus PIRG chapters to personally visit their faculty to explain the benefits and high quality of open textbooks.
- Created the "Open Textbook Catalog" [8] featuring open textbooks that are *in use* at colleges and universities and sponsoring paid reviews by faculty familiar with the texts.

The AIM Editorial Board will take this process one step further by providing a knowledgeable independent evaluation by experts in the discipline. AIM is one of the seven NSF-funded mathematics institutes, which provides a level of credibility in the mathematics community. We believe an independent evaluation by AIM will carry significant weight with potential instructors. Also, we believe AIM's efforts to develop an approval process will generate some publicity in the community. This will address two of the main barriers to adopting free textbooks: the lack of awareness by many instructors that free books are available and the perception that they cannot equal the quality of the commercial counterparts.

6.3. **Dissemination audience.** PI Beezer and AIM Director of Programming David Farmer are involved with the Community College Consortium for Open Education Resources and have discussed AIM's plans for free textbook approval with CCCOER director Jacky Hood. In addition to the proposed website, AIM will make free textbooks part of its outreach efforts, including advertising at the AIM booth at the national Joint Mathematics Meeting each January. The Student PIRG campaign can provide very broad exposure for our efforts.

6.4. **Broad appeal of open textbooks.** The proposed approval process for free textbooks is not limited to the Sage-enabled books considered in this grant. We believe that the barriers to adopting Sage-enabled books is comparable to those facing free textbooks in general. The AIM approval process will provide detailed information about the suitability of these textbooks, including information on the technical requirements (which will be low for those books passing approval). We believe this will enhance adoption in the wider community.

7. Budget

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.** 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 initiatives 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 from the SCREMS program, and will be maintained by the University of Washington for the duration of the UTMOST project.

7.3. **Reallocated technology expenditures.** 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 availability 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

8.1. **Human subject approval.**

TODO: In-progress, verify status at last minute.

8.2. **Budget impact summary.** 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 proposed 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 interacts and subject guides 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 additional textbooks that will be Sage-enhanced and the contributions of code, interacts and subject guides to Sage, 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 initiative 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) purchased a new laptop (partially funded 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.

9. Timeline

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		Form Editorial Board, design requirements	Release textbook requirements	Evaluate first group of textbooks	Create website: requirements, approved books	Evaluate second group of textbooks	
Beezer	Textbook conversion system	Sabbatical leave: Textbook content Sage library	Textbook conversions: content, system	Liaison, Reed	Textbook conversions Interacts, subject guides	Liaison	
Grout			Notebook Improvements Interact search Sage Library Interacts	Liaison	Notebook Improvements Textbook conversions Interacts, subject guides	Liaison	Notebook Improvements Sage Library Subject guides
Hassi		Pre-workshop survey Post-workshop survey design	Observe workshop Post-workshop survey	Site visits Surveys: Test site, pre-workshop Interview design Data analysis	Observe workshop Post-workshop survey Data analysis Teacher interviews	Data analysis Test site surveys Teacher interviews	Data analysis Final report
Judson	Abstract Algebra textbook preparation	Textbook preparation and conversion	Textbook conversion	Liaison, SFASU	Evaluation	Evaluation Liaison	Evaluation
Kedlaya				Liaison, CSUDH			
Stein		Notebook scalability Notebook management features	Number theory textbook Notebook support for textbooks	Notebook support for textbooks	Notebook features, scalability Textbook conversions Liaison, NSCC	Notebook development	

References

[1] Research experiences for undergraduate faculty, AIM Workshop, July 2009, http://www.aimath.org/pastworkshops/relant2.html

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

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

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

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

[6] Make Textbooks Affordable, The Student PIRGS, http://www.studentpirgs.org/textbooks/campaign

[7] National Association of Mathematicians, http://www.nam-math.org/

[8] Open Textbook Catalog, The Student PIRGS, http://www.studentpirgs.org/open-textbooks/catalog

[9] Sage Notebook Servers, http://wiki.sagemath.org/sagenb