

Bluenote: Planned research studies for Joe's thesis

Joe Corneli
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Executive Summary: I describe two small-scale pilots (to be conducted between December 2011, and April 2012), and one larger scale research study that will run “in the wild” on PlanetMath.org approximately from April 2012 to September 2012. Where appropriate, I describe possible grant support for this work.

Outline of research studies

My research agenda consists of two qualitative pilots, and one larger, more quantitative, “in the wild” study.

Both small-scale pilots could be repeated with variations if it proves useful to follow up with additional “subjective” user experience work, and I anticipate that this will be the case. For example, this would allow us to see if the way people use the new site is substantially different from the way they use the old site.

The larger-scale study should address fundamental questions like “Are people learning?” and “Is the content improving?”. The framing assumptions of this work are as follows:

- People will learn mathematics by using the PlanetMath website.
- The existing knowledge artifact (encyclopedia) will be useful for learners.
- Student questions will lead to improvements in the encyclopedia.

My aim is to understand the gaps in the peer-production, crowdsourcing, methodology – places where technical work can help people learn. The two pilot studies will help me better understand the dimensions of analysis, and suggest some preliminary technical systems to deploy in the large-scale study.

(1) Alpha testing and historical review with PlanetMath top contributors (December, 2011) Starting in December 2011, I plan to invite the top 20 to 30 “top users” of PlanetMath to test out the new site, to give feedback on usability and features. In addition to asking for feedback on the site, I will include some questions that will help me understand their motivations and experiences with PlanetMath. I will invite participants to discuss further in a semi-structured interview, hoping to finally answer a question we are frequently asked, “who are PlanetMath’s contributors?”. This could be followed up with a survey (to be deployed, for instance, when we are ready to launch the feature-complete beta) to answer the question “who are PlanetMath’s users?”, as these groups are somewhat distinct.

- Draft questions are presented in Section ALPHA QUESTIONNAIRE.

(2) Classroom testing at Liverpool Hope University (Spring, 2012) In January 2012, I plan to start some testing with a very different group of users: undergraduate mathematics students enrolled in formal courses at Liverpool Hope University. The idea

here would be to work together with their instructor(s) to come up with some learning scenarios that involve using the Planetary software (for example, add some problems to the site, discuss them there, and work out solutions together). Survey questions will get at (new) user experiences with Planetary.

We can also test out methodological approaches, like asking students to self-evaluate “How hard was this problem for me?”, solving a given problem. Feedback from course instructor(s) about how well the software matches their requirements will also be useful.

- This study could potentially with the £2000 HEA/JISC funded “Case Study” call (proposals due Friday, 9 December 2011).¹ Here we would develop the “OER and student as producer” theme. Can students get value and add value to the site? The money could be spent in part to compensate student participants or coordinators, and in part on small Drupal improvements prior to the study.²
- A \approx 500 word abstract is presented in Section CASE STUDY ABSTRACT.

(3) Large-scale data investigation (Summer, 2012) I am hoping that a feature-complete “beta” of the PlanetMath website will be live by April 2012. In any case, I plan to pull myself out of site-building work at around that time, and focus instead on data analysis. If we do not have sufficient new data at that time, I will see what I can do to analyse the previous 10 years of legacy data. Outcomes I will be focusing include identifying sequences of action where learning takes place, and conversely, mapping learning scenarios into activity patterns on the website.

My sense is that the analytic tasks I am interested in doing in this phase will be supported well by SPARQL integration into Planetary, which will enable me to produce interesting “feeds” showing learning-relevant activity on the site. The other tool that will be brought to bear in this phase is light weight text analysis (see my paper with Marisa Ponti³).

- The technical aspects of this study could potentially be supported by the £10000–£25000 JISC-funded OER Rapid Innovation call, in the “Enhancing platforms for open content” strand (proposals due in January of 2012).⁴ I’ve already drafted a lot of material for a related call, much of which I think could be reused here.⁵ The funding would mostly be spent on supporting development work which would take place during Spring.

One question to check here is whether “technical staff are already in place”. Since commercial and overseas partners are welcome, maybe some funds could be dispersed to members of the existing Planetary team.

- An overview of similarities and differences between this submission and the earlier draft material is presented in Section GRANT SKETCH.

Summary I mostly spent 2010 on planning, and 2011 on design, prototyping, and implementation: 2012 should be spent mainly on research about users and use data.

¹[HTTP://WWW.HEACADEMY.AC.UK/ASSETS/DOCUMENTS/OER/OER_CALL_FOR_ABSTRACTS.DOC](http://www.heacademy.ac.uk/assets/documents/oer/oer_call_for_abstracts.doc)

²[HTTP://WWW.COMPUTERMINDS.CO.UK/DRUPAL-FREELANCE-WEB-DEVELOPERS](http://www.computerminds.co.uk/drupal-freelance-web-developers)

³[HTTP://METAMESO.ORG/~JOE/DOCS/DETECTING-LEARNING.PDF](http://metameso.org/~joe/docs/detecting-learning.pdf)

⁴[HTTP://INFTEAM.JISCINVOLVE.ORG/WP/2011/11/16/OERRIPREVIEW/](http://infteam.jiscinvolve.org/wp/2011/11/16/oerripreview/)

⁵[HTTP://METAMESO.ORG/~JOE/DOCS/OER-PHASE-3-WEB2PROBS-V5.PDF](http://metameso.org/~joe/docs/oer-phase-3-web2probs-v5.pdf)

This final phase will be the main scientific contribution of my thesis: an improved understanding of how to better support mathematics learning.

Alpha questionnaire

- (a) Mathematical background and goals.
 - (i) How would you describe your mathematical background?
 - (ii) What are some of your mathematical ambitions?
- (b) Previous experience with PlanetMath.
 - (i) How do you use and/or contribute to the PlanetMath website?
 - (ii) What motivates you to use it?
 - (iii) What is something you remember learning about on PlanetMath?
 - (iv) What has been difficult or tedious to do on the old PlanetMath site?
- (c) Impressions of the new site.
 - (i) What is most striking to you about the new site?
 - (ii) What features do you most miss? (These could be things that were present on the old site, or new things you'd like to see in future versions of the site.)
 - (iii) Did you notice any bugs or issues worth mentioning to the developer team?
- (d) Would you be willing to be contacted for a short interview? (If so, please indicate preferred contact details.)
- (e) Basic demographics (age, gender, education level, etc.)

Case Study Abstract

Introduction Learning via contributions to a wiki has been successfully deployed in fields like Sociology and English. In technical fields, student work typically takes the form of problem solving tasks. The question about how best to study and work in a knowledge-rich world is not well understood. Our hope in this case study is to demonstrate that student contributions can play an important role in creating increasingly complete and increasingly useful OER in technical subjects.

Background PlanetMath.org is an open, peer produced website for mathematics, built around a Creative Commons mathematics encyclopedia defining over 15000 terms. Recently, PlanetMath's software has been rewritten, using the open source CMS, Drupal, along with special-purpose extensions for working with mathematical content. In addition to overhauling and updating the site's look and feel, we have added support for new kinds of learning interactions: (1) problems and solutions are now hosted on the site, and are automatically linked into the encyclopedia; (2) we have enabled real-time collaborative editing software as standard throughout the site, making it easy for people to work together on problem solving or tutoring interactions.

Outcomes The aim of this case study will be to examine the potential role of student produced material in this environment. Student contributions on PlanetMath can range from questions in the forums, to contributed problems, to worked solutions, to peer mentoring. Interested students will be able to contribute as full peers, making requests, corrections, and

critiques and direct contributions to the encyclopedia. We will look for ways in which two kinds of outcomes can be supported:

- (1) We will look for evidence that student interaction about problems will lead to improvements in the encyclopedia (for example, when autolinked encyclopedia articles do not provide enough information for a student to solve a given problem, it would be justifiable to ask for improvements to the articles in question).
- (2) We will look for learning outcomes for the students themselves.

Research design We will compensate students enrolled in mathematics courses at Liverpool Hope University for hours logged working on problems on an “alpha grade” version of PlanetMath’s software. Our strategy will be to ask students to use a combination of “talk-aloud protocol” and post hoc reflection questions (how hard was this problem for me? How did the knowledge repository help me in my task? has the software helped or hindered?). Talk-aloud transcripts will be logged using the open source cross-platform program Audacity. Two in-person workshops will be held to train students on use of the software, and to encourage peer interaction.

Budget We plan to split the £2000 from the case study award between software improvements (£500 before the study, £500 after the study) and student compensation (100 hours at £10/hour).

Grant Sketch

Introduction Basically the project has two goals: the first is to build a platform that supports mathematics learning, and the second is to build tools that will help us measuring when learning is happening. Work on the first part is underway (see Kohlhase et al.⁶), and high-level ideas about how to do this are sketched in Corneli and Ponti (submitted, see Page 2, Footnote 3).

Phase I The first goal to make a rock-solid platform that is useful both for informal self-study, and more formal learning within institutions. This is almost entirely to be done with standard Drupal work, and I think this is a place where (if it’s possible) it would be good to make use of Drupal subcontractors. Otherwise, if there are technical people at LHU who are good with Drupal, we can work with them. Specifically we want good support for courses (i.e. for both teachers, students, other content producers, etc.). For concreteness, let’s say that this amounts to 4 weeks of professional programming, or half of the programming budget. I’d like some more input from Anesa on what features exactly are needed for the LHU setting, and what kind of uses her colleagues might have in mind for this kind of software. (Note that we can build on earlier work at LHU, including the CASE STUDY ABSTRACT.)

Phase II The second goal is reached by building on the first, and a combination of learning science and technical programming than platform building. Myself and potentially others at KMi would be well-equipped to deal with (most of) the programming task, with some help

⁶[HTTPS://SVN.MATHWEB.ORG/REPOS/PLANETARY/DOC/EPC11/PAPER.PDF](https://svn.mathweb.org/repos/planetary/doc/EPC11/paper.pdf)

from the existing Planetary dev team, and, potentially, some help from the Drupal experts. The work in this phase boils down to (a) textual analysis; (b) metadata management via Virtuoso/SPARQL. Our aim is to generate feeds (queries) showing learning-relevant activity in the site.

Budget One clear requirement in the call is that the technical staff should already be in place. I’m inquiring with the programme manager as to whether it is possible to hire professional subcontractors for any part of the work. At £500 per day, we could afford 50 days, or 10 weeks of programming, if we spent the entire budget on professional work of this nature. I suspect it’s a better bet to set aside at least 20% of the budget for other needs (travel), but it is OK for this to be a development-focused project (6 weeks of professional Drupal work, 2 weeks of in-house work with Virtuoso/SPARQL). This is summarized in Table 1.

Drupal work	6 weeks	£15000
Text analysis and metadata	2 weeks	£5000
Project management, travel	–	£5000

Table 1: Budget summary

Differences to earlier draft proposal This proposal is much more tightly focused, partly because some time has gone by, the prototyping work has been going well, and we know much better what needs to be done⁷, and partly because the grant itself would be much smaller.

We can also build on experiences gathered in the two pilot studies, in other words, we will have a good understanding of the features that are desired both by hardcore contributors and by students, so we can focus our energies on building these.

⁷Deyan Ginev: “It seems we should contribute two modules to the community: one which extends the RDF mappings to text fields (where the LaTeX-authored metadata resides as RDFa), and one which exports metadata on edit to an external triple store”; see [HTTP://DRUPAL.ORG/NODE/1338778](http://drupal.org/node/1338778)