Interim Report, EOAS large TLEF October 2016.

Project Title: Development of cost effective strategies for teaching, learning and assessing scientific reasoning abilities in large face-to-face and distance education general science courses

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Funding Year of Report: (2016/2017)

Summary of work accomplished to date: *In terms of what you originally intended for the project, what has already been completed and what is the project on track to accomplish by the end of the funding year (i.e. March 31)?*

Overall, good progress has been made since starting in May 2016.

- A scientific reasoning assessment emphasizing a natural hazards context has been developed, with reference to precedent regarding critical and scientific thinking and earth science concepts. A first version of this assessment was administered in early September to 578 face to face (f2f) and 346 distance education (DE) students. Initial results are being analyzed with help from graduate student teaching assistants. The assessment will be administered again in December 2016 and results analyzed to compare students' abilities early and late in the course, in different sections of the course, in f2f versus DE settings, and between students with various demographic characteristics. The aim is to improve the assessment as an effective, efficient and ongoing measure higher level thinking.
- Also, 819 students in f2f and DE completed the Student Perceptions about Earth Sciences Survey and results will be analyzed after the second dataset is gathered in December.
- A new framework for the course has been conceived and is being refined during the 2016W fall term. Starting Jan 2017, we will begin deploying this framework as a pervasive structure for all modules of the course.
- Standard assessment practices in use for DE students have been analyzed and strategies for improving effectiveness, sophistication and fairness of DE testing will begin to be developed in January 2017, based on results of these analyses.
- Homework and active classroom techniques are being conceptualized with support from one of the two faculty buy-out positions this term. This buy-out is being paid to Dr. L. Porritt who is currently the course administrator for eosc114 and who will be teaching several of the modules in fall and spring 2016W.
- Opportunities and challenges related to student projects are expected to emerge following introduction of smaller-scale active learning initiatives in classes, for DE students and as homework.
- Homework, active learning techniques and projects will be extended into the DE course context following piloting within the f2f setting.

Changes/modifications to the current or future scope of the project: *What changes have you made (if any) in light of the work undertaken to date? Please explain why these changes are/were needed, and how this affects evaluation of project outcomes.*

There are no anticipated fundamental modifications to the final scope of deliverables for this project however we do intend to take advantage of circumstances to adjust the priorities and schedule of deployment and evaluation schedule. Five aspects that will be affected are as follows.

1. There were two project components related to **concept inventories** outlined in the original project proposal; a scientific thinking assessment and geoscience concept test involving natural hazards. One shift in the project is that these two concept inventories will end up getting "merged" because we now believe it more appropriate to test "*scientific reasoning in the context of natural hazards*" rather than testing "*scientific reasoning*" separately from "*natural hazards*". This assessment will also likely evolve from a discrete test towards a "disseminated test"; ie. towards deploying questions at various stages during the course as parts of quizzes, tests and assignments as well as with some separate short surveys. A primary challenge has been (and continues to be) generating equivalent higher-level thinking assessments for both f2f and DE students.
2. Introducing **framework concepts** for the whole course is a key to ensuring that students encounter a uniform learning experience from all instructors. It also helps students align new knowledge and skills with subject concepts that are consistent with the ways experts think about the discipline. However, adjusting content is very challenging when instructors only teach 5 lessons each. Fortunately, the course will be taught by a smaller team in winter 2016W and inserting the framework into lessons will be more practical at that time. To accommodate this opportunity, initial efforts to introduce student projects will be delayed until a later term.
3. **Student projects and homework** are being considered during fall and winter terms of 2016W, with first deployment anticipated for later in 2017. Rather than designing projects directly, we chose to work more incrementally by considering options for regular homework before tackling "projects". This is because some instructors are concerned about logistics of managing projects for hundreds of students with such diverse backgrounds and interests. Smaller scale adjustments to student work will be easier to implement, and "projects" can then emerge as "larger scale" homework. Consequently, final versions of projects may not get tested until late in the project or perhaps one or two terms beyond. This will not change project outcomes nor budget, but may result in the need to extend final project deliverables and evaluations beyond the original 2 year timeline.
4. **Enhancing online assessments** involves using data from prior existing practices, but it has been difficult to extract necessary data from Connect. However, the problems have been overcome and we are proceeding by using results of this analysis to refine existing assessments. The first step is to reduce the large number of questions by removing ineffective questions based on item analysis from use in prior terms. The second step will be to align questions with the new course framework. Then a variety of question types and tasks will be developed so that students are fairly assessed at more meaningful tasks. Instructional designers at CTLT will likely be helpful at this stage. The first refinements should be introduced in 2017, with the first enhanced assessments planned for introduction one or two terms later (including summer terms). Subsequent terms will see continued improvements.
5. All aspects related to specifically to **improving the DE version** of the course will likely be delayed owing to some unanticipated personnel challenges. From the project's point of view, we are treating this as an opportunity rather than a problem because, based upon experience in our Department, building and testing such experiences simultaneously in both f2f and DE settings would be more difficult than optimizing the experiences in one setting first. The consequence will be a shift in the project from working in f2f and DE together to enhancing some aspects of DE sections after making changes to f2f sections. We will be asking for time extensions but with no changes to the total budget.

Work plan for the next year: *What are the project goals in the next fiscal year for which you are seeking funding?*

Project goals remain essentially unchanged, however we aim to stretch the deliverables timeline without changing the budget so that the project concludes up to a year later than originally planned. This is partly to accommodate a "serial" rather than "parallel" model for improving f2f and DE versions of the course. Our second project year (May 2017-April

2018) will involve refinement of concept assessments, homework and student projects, active learning and concept frame-working in face-to-face settings. The focus on distance education will begin to ramp up in summer 2017 rather than the original plan of working on both settings concurrently. Consequently, we will request somewhat reduced funding for the second year, and request remaining funds for a new (likely partial) third year. Details are in the next section.

Budget implications from any of the above: *Have the current, actual, or intended project expenditures changed as a result of any changes to the project's scope? Please provide brief details.*

We propose to shift the project model from simultaneous updates to DE and f2f versions of this course to a model in which some work on assessments is done for both versions, but active learning is introduced to f2f sections first and DE sections in subsequent terms. This will require less work in the remainder of year 1 and in year 2, followed by continued implementation of final project components and evaluations for several months beyond year 2.

The work has been planned to cause no change to the overall budget, although we anticipate shifting some expenditures to later dates. For example, there were two faculty buyouts originally budgeted for year 1 (May2016-April2017) but we now anticipate spending one of those buyouts in either the summer or fall terms of 2017. Similar shifts will occur for one each of the graduate research assistantships and undergraduate research assistantships and for some of the media and production support. Our understanding that it will be reasonable to shift the actual expenditure of such items into the months immediately following the fiscal year for which they were planned, so long as we request this shift with suitable justification.

The one change to the budget since it was originally proposed is that for the upcoming second year (2017-2018), we anticipate paying the Teaching and Learning Fellow at 60% of the original "ask", then requesting a third year of salary for this TLF at 45% fte to accommodate the adjustments to the project timeline noted above.

Students already impacted - or yet to be affected - by the project

Course Code	Sections	Enrollments	Academic Year	Term (Summer/Fall/Winter)
Eosc114	101, 102	619	2016W	Fall (f2f)
Eosc114	99A	330	2016W	Fall (DE)
Eosc114	201, 202	510	2016W	Winter (f2f)
Eosc114	99C	165	2016W	Winter (DE)
Eosc114	971	200 (estimated)	2017S	Summer (f2f)
Eosc114	98A	300 (estimated)	2017S	Summer (DE)
Eosc114	101, 102	620 (estimated)	2017W	Fall (f2f)
Eosc114	99A	330 (estimated)	2017W	Fall (DE)
Eosc114	201, 202	510 (estimated)	2017W	Winter (f2f)
Eosc114	99C	170 (estimated)	2017W	Winter (DE)
Eosc114	971	200 (estimated)	2018S	Summer (f2f)
Eosc114	98A	300 (estimated)	2018S	Summer (DE)
Eosc114	101, 102	620 (estimated)	2019W	Fall (f2f)
Eosc114	99A	330 (estimated)	2019W	Fall (DE)