Annual formative evaluation report
Global Cyberbridges Project (GCB)
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Report Overview

This report first discusses the components of the project (class and four collaborative groups) separately. This is followed by a brief history of the collaboration between institutions over the first year and use of distance collaborative technology. Finally, some general conclusions and recommendations are given as is appropriate for a formative evaluation.

The report will focus more on online learning and collaboration than the scientific achievements of the groups. We believe much can be learned from the project's progress towards developing an effective set of procedures for virtual teaching and collaboration, lessons which need to be made explicit and applied as the project continues. Good science has also been done but one year is too short a time for significant publications and other progress metrics to become available.

Required Course

Dr. Masoud Sadjadi instructed a class at FIU during the Spring 2007 semester entitled Special Topics in High-Performance Grid Computing and Research Networking (FIU# CIS 6612) for students in the GCB program. This was an international class taught physically at FIU in Miami, Florida and virtually, using Polycom video conferencing systems, in Beijing, China. Class was held on Thursdays at 8-10:40 pm, Miami time; Fridays 8-10:40 am, Beijing time. As noted in the course syllabus[1], the course covered "fundamental concepts of high performance computing as well as hands-on experience of the core technology in the field." Topics covered included both cluster computing and multi-site grid computing. Students gave presentations and did a project that required them to prepare a scientific application for grid computing, testing it on a cluster (primarily the GCB cluster at FIU). The class also began using the SAGE Tile Display Wall to share both student and faculty presentations.

Dr. Sadjadi reported that the class went well and (in spite of the time difference) attendance was excellent. He felt at first that the video was distracting, but then assigned a student to navigate the camera so students could see each other as well as the instructor. He used instant messaging during class time to answer questions or advise international students where they were in the lecture or PowerPoint slides so they could follow along without disrupting the flow of the lecture. Although Dr. Sadjadi reported few language problems in the class, he noticed some cultural issues, for example, use of humor by the American students which might have excluded the Chinese students.

The class was assigned a number of parallel programming projects using cluster and grid computing software with the goal being an understanding of what it takes to develop a parallel

program on a given computer facility in theory and in practice. Dr. Sadjadi noted that in the beginning there was little discussion and the lecture was one-sided. He felt the students in Beijing were hesitant to interject comments. Dr. Sadjadi altered his teaching method and assigned each student a lecture (using instructor slides) based on their individual interests. He worked individually with each student and prepared them for their lectures ahead of time so that they did not have any problem in explaining the contents of the lectures. Each student delivered a lecture and demonstrated practical solutions to a number of sample problems. This provided each student with the opportunity to speak in front of the group and allowed each to see and get to know the other students. This proved successful and resulted in better communication among them. Further discussion of the course communication tools is included in the paper written by the collaborative platform group, "Formative assessment of the effectiveness of the collaboration in GCB"[3]. See our discussion of the activities of that group below.

An important contribution of the class to the collaborative groups was the opportunity it provided for group members in the different countries to interact visually and thus get to know each other before moving to the primarily asynchronous text communication used in the work of the groups. It is also important to note that GCB differs from most other virtual learning contexts in that students and their advisers are performing complex work in implementing high performance computer applications of scientific projects. It is doubtful that this could have happened without the class with its visual synchronous communication.

At the same time (as is discussed in more detail under institutional arrangements below) the international collaborative aspect of GCB was not directly addressed in the class as it focused on learning theory and technology. Since the class turned out to be the only opportunity for all project participants to interact "face to face" this should have been addressed directly. However that would have required a synchronous shared workspace so students could learn how to interact with systems like the GCB cluster from a distance.

Over the summer and this fall the four groups have been working on their projects:

Project 1: Starch Polymer

This project uses simulation tools to investigate whether certain biodegradable starch polymer compounds will be sufficiently stable to have practical utility. The main simulation tool for computational quantum chemistry used by the project is the Molpro program the group installed and used on the FIU GCB cluster. Technical aspects of the installation and use of this software proved to be a major challenge, but the project is now moving forward with the technical problems solved. This success was the result of a noteworthy international and interdisciplinary collaboration that emerged among the three members of the group. The group, consisting of a FIU biochemistry graduate student and two graduate students in information technology at CNIC/CAS[2], made extensive use of Moodle and email (meeting on occasion via VOIP/Skype) to communicate and solve the technical implementation problems. The group is now writing a paper on the installation and use of Molpro in cluster and grid computing environments for computational chemistry problems aimed at a multidisciplinary IT/biochemistry audience.

As we on the assessment team reviewed the extensive communications of this group on Moodle, we were very impressed by the frequent, effective interaction and excellent (but not intrusive) facilitation by Dr. Sadjadi.

Projects 2 and 3: Hurricane projects

Hurricane mitigation and visualization are separate projects, but we consider them together as they depend on each other, requiring joint effort and group meetings. The mitigation project will provide massive amounts of data output which the visualization project will package for various audiences using 3-D animation and related technologies.

The mitigation group is working on moving the Weather Research and Forecasting model (WRF), which currently runs on clusters, to a multi-site grid implementation. They are running simulations on the GCB cluster to study the effect of timing and synchronization over the internet--scheduling issues that have to be resolved for the grid implementation. Activity has also been focused on getting the best implementation of WRF for this task. In this project the GCB student participants are working with a large team of researchers. Most communication occurs through a project mailing list (highly technical in content of messages) and many meetings (participants present in person and by conference phone). These meetings are fairly easy to arrange because the regular attendees are all in the U.S., and can be held at a time that would be impossible for people 12 hours away. The one student from China involved in this group found it very difficult to get up to speed with the WRF technology (probably in large part given the advanced discussion on the mailing list, and problems with email communication). She later submitted a report which contains a good overview of the group's goals and tasks, observations on the difficulties she faced, and useful recommendations for improving communications.

The visualization project focuses on cluster and grid implementations of current work at FIU on 3D visualization and animation of hurricane impacts. Here also the linkage is with a large body of ongoing FIU research, albeit with one professor who is a leader in this field.

Overall, in the opinion of the evaluation team, the hurricane groups have made less progress than the other two in the work they have accomplished. We feel this is in large part because they do not have a task of their own but are rather engaged in large complex research projects with many participants.

Project 4: Collaborative Platforms

This project is composed of two graduate students, one from USA and one from China, and two faculty advisers from USA. Its goal is to obtain from the GCB experience lessons for providing a more convenient, efficient, and productive collaborative platform. To reach this goal, the two students in this project have been observing, participating and studying the distributed and interdisciplinary collaboration of the project teams. They developed an online questionnaire for GCB participants (appendix 1) and produced a paper with their findings (appendix 2). An important conclusion reached by this group concerns the multiplicity of communication modes used by GCB groups: "Text Systems (which includes Instant Messaging, E-mail, Wiki, Forum [Moodle, WRF mailing list]), Audio Systems (which includes Telephone and VoIP Conferences), Video Systems (which includes PolyCom and Skype video conferencing systems) and Face-to-Face Meetings". All of these have been used (some simultaneously like Polycom and IM during the class). Text asynchronous messages were most heavily used for reason of comfort and convenience as well as overcoming the time difference—here the multiplicity of methods produced some problems with passwords and choice of correct route for a given communication. Synchronous communication is necessary for group meetings, but even audio (Skype etc) was made difficult by technological issues. Group meetings are essential, and even many one-on-one interactions where both are working with a computer interface would be greatly facilitated by a synchronous shared workspace.

While the technological challenges faced by this group may have been less than the other groups, its importance to GCB cannot be underestimated. It builds a reflective capacity that is constructive, enhances overall learning, and serves the purpose of the project to develop the potential of international cyberinfrastructure research and learning collaborations.

Institutional and technical collaborations

The achievements of GCB and obstacles it has had to face did not occur just at the level of the class and collaborative groups. The arrangements between institutions in different countries and the timing of those arrangements were also very important. Equally important was the implementation of visual collaborative learning technologies. Here we briefly recount the project history in both of these areas.

The basic GCB project included three key partners: FIU in Miami (the NSF grant awardee); CNIC (Chinese Academy of Sciences); and University of Sao Paolo, Brazil. As University of Sao Paolo was not ready for the initial year of the grant proposal, for 2007 it was decided to continue with just two key participants, FIU and CNIC. Furthermore, City University of Hong Kong joined the project as a coordinator and intermediary for two reasons: CityU's expertise in the use of group technologies, computer supported collaborative work, and implementing and managing virtual teams. Second, its geographical and cultural proximity to Beijing, and its access to both technology and intellectual resources made CityU a natural as an intermediary between Chinese and US partners.

Following the success of the previous CyberBridges model implemented and tested at FIU, the GCB project was initiated in a manner similar to the Cyberbridges project. However as the following history shows, the CyberBridges process had to be modified to account for the fact that GCB is not a single site, single institution project, but includes collaboration between a set of globally distributed, independent partners.

The GCB project was approved by NSF at the end of October, 2006. Following the Cyberbridges model, the FIU team established a call for proposals for selecting GCB projects and circulated it within the FIU student community. Based upon the proposal submissions, by December, the FIU team selected five projects submitted by FIU students. Again, following the FIU Cyberbridges model, a course for teaching advanced networking concepts was established at FIU and the five projects were made part of this project. Later, one of the students proposing the projects was counseled to drop out of the 2007 GCB team due to upcoming field work requirements for her dissertation and heavy demands to augment her technology background via a programming class. In late December, early January the Chinese and Brazilian partners were contacted to join the course and assign students to the FIU defined projects.

At this time a number of things became apparent. First, FIU had scheduled the course to begin at the time coinciding with the Chinese New Year's celebrations in China and the Mardi Gras in Brazil. Somewhat like Christmas and New Year break in the US, but even more intense, all work ceases in China and Brazil during these weeks. Thus it was not possible to get any response from China or Brazil during the month of February, and we could not start the course and the projects at the scheduled time. About the same time Brazil postponed their active participation in the GCB project by one year and decided that for the first year they will participate as observers only. This was fortuitous, at least for the first round, in that it reduced the potential complexity of coordinating three very different partners at three global sites, with all attendant, distance, time, culture, and infrastructure gaps.

Second, the FIU team discovered that during the past year, the Chinese partners had acquired a number of funded grants with other collaborating agencies, such as the European Union. Unlike the NSF grants, some of these grants provide funding to be shared between the partners from the granting countries and their Chinese partners. Third, given the proposed structure of the collaboration, where the projects were proposed and were to be managed by FIU, the Chinese felt that these were essentially American projects, and did not feel as if they were being treated as equal partners. Fortunately, at the behest of and encouragement from a FIU investigator visiting CNIC/CAS one of the Chinese students proposed a project on studying collaborative platforms that was included in the list of the GCB projects for 2007 (see project 4 above). This visit and the direct, in-person attention to the Chinese students helped in bringing them into the GCB fold.

A combination of these factors led to a less than enthusiastic initial response from the Chinese partners. This rocky start had to be overcome with frequent face-to-face meetings which took place at PRAGMA in Bangkok, Beijing and Xi'an for the CANS conference. The following table details the attendees at these meetings and the timing.

Participants	Location	Dates	Meeting Venue
Kuldeep Kumar Julio Ibarra, Kai Nan	Osaka, Japan	10/13-19/06	PRAGMA 11 (Peter Arzberger, PI)
Kuldeep Kumar and CNIC of CAS Pis, staff, and students	Beijing, China	10/25-28/06 3/14-17/07	Global CyberBridges Meetings
Heidii Alvarez, Julio Ibarra, Kai Nan, Jane Klobas	Bangkok, Thailand	3/17-23/07	PRAGMA 12
Heidi L. Alvarez, Kuldeep Kumar, Julio Ibarra, Fang Qian, Hang Xing	Xi'an, China	8/23-27/07	Chinese American Networking Symposium
Heidi L. Alvarez, Julio Ibarra, Kuldeep Kumar, CNIC of CAS Pis, staff, current students, and future students	Beijing, China	8/28-30/07	Global CyberBriges Meeting

By the time of the CANS and Beijing CNIC of CAS meetings afterwards, there was a strong rapport developed and enthusiasm to continue GCB into Year 2. The Chinese PI and Coordinator along with the US staff were in favor of having Year 2 GCB students meet in Hong Kong, since obtaining Chinese student visas and travel support for any international travel is quite difficult.

A further factor was the near exclusive orientation of the class to initial learning of advanced networking concepts. This did not facilitate GCB's primary objective to establish, promote, and investigate the formation of collaborations between young scientists in the two countries.

Finally, the project was also hampered by the Chinese partners' lack of opportunity for gradual face-to-face (real or virtual) relationship building, essential to building the trust required for institutional collaboration as well as for successful online learning communities (Pallof and Pratt 2007: 26, 228 [4]). The American participants had ample opportunity for this. This points to the

need for travel opportunities, something that needs to be discussed in detail since it is important for the future success of GCB. In the GCB budget, travel funds for the PI, Co-PIs, and GCB fellows were requested for domestic travel in the amount of $6914, $6404, and $6165, and for international travel in the amount of $19,508, $20,000, and $20,000, for three years respectively. Due to budget constraints at the NSF in FY06, the actual amounts funded were $12,800, $11,175, and $10,395 for three years respectively. Given our current knowledge, even the full amounts would not have stretched throughout the 3 years GCB needs to develop, especially once Brazilian students, faculty, and technologists join the collaboration. The domestic funds are designated to be used to support travel between USCD, FIU, and other university and conference sites for collaboration on the deployment and functionality of grid cluster, high performance networking, and the Sage system. The international funds are designated to be used to support travel to China, Hong Kong, Brazil, Osaka and other PRAGMA conference sites to build trust and common ground among the FIU Co-PIs and GCB fellows with the international partners. When applicable, these travels are being heavily augmented with remote synchronous communication. Nevertheless, these travels in person are viewed as essential for the success of the GCB project.

From the original travel budget, it was expected that a portion of the budget could be used for traveling with GCB fellows to appropriate conferences, workshops and meetings (1) to support and disseminate the grid based domain science and engineering research and (2) to accompany our GCB fellows with a mentor who can introduce them to the pioneers of their field so that the fellows can build a strong network for their future careers. The need for this is evidenced by the fact that GCB has a conference publication in less than 6 months since the start of the CI training class and is expecting to have at least four more conference publications, which will be submitted before the end of year 2007 or in early 2008. These are important measures of the success of GCB and the ability of other institutions to learn from its experience. Unfortunately GCB's budget is currently unable to support travel and registration costs required for conference presentation of these publications.

Technical capabilities and collaborations

Installing the SAGE Cyber Infrastructure: FIU, CNIC/CAS and City University of Hong Kong have installed the SAGE software and the associated hardware, known as the Tile Display Wall or TDW. Moreover, in preparation for GCB, participants from all three locations have attended training programs and tutorials in San Diego (CNIC of CAS remotely, FIU on-site) and Singapore (CityU). During the testing of the SAGE system at CityU Hong Kong a number of problems with its installation and use were discovered and conveyed to the project team at UC San Diego during 2006 summer/fall. CityU awaited a response from the UC San Diego Team for some time, but no personnel from CityU were able to attend the 2007 SAGE TDW summer workshop at Calit2 to get their questions resolved. Moreover, at this time none of the sites have received all of the collaboration tools they would like made available within the SAGE environment, such as audio to accompany video conferencing. We understand that Calit2 and EVL (UIC) are working on a new release and when it becomes available Calit2 will do the technology transfer to the GCB partners. At the start of GCB there was a lack of user-friendly documentation describing how to assemble the TDW and any available collaboration-support features and tutorials in its use. Some of these problems were solved for FIU and CNIC of CAS over the summer. The NSF funded 1 REU position and the student completed a technical

manual on how to assemble the TDW as well as documenting the components of the GCB teaching grid computing cluster. The Calit2 network engineer, who is partially funded by GCB, developed tutorials on the SAGE TDW software and how to program SAGE calls to display images on the wall. All of this documentation is now available on the GCB web site www.cyberbridges.net.

The SAGE development team is currently focused on obtaining additional funding to develop the collaborative aspects of the technology. For SAGE TDW to reach its full potential time and priority must be given to responding to its users, as well as preparing and testing its features in use by typical end-users. GCB is very anxious for this maturity to occur, since other collaborative environments are either extremely expensive (e.g. CISCO TelePresence), require high overhead and lower resolution (Access Grid), or do not scale to the needs of intense collaboration for the sharing and creation of new knowledge collaboration (e.g. Skpe, MSN, Net Meeting, Instant Messaging). GCB project researcher Dr. Kuldeep Kumar, a person very knowledgeable about computing in business organizations, observing this process notes that much experience has shown that, unless strict accountability to the end-users is formally established, technologists are often focused primarily on technology development. Responsiveness to the end users' needs is usually not a priority for technology developers unless it is formally established.

To meet with the immediate objectives of the GCB Project of establishing international collaboration without SAGE being functionally able to provide the full spectrum of collaborative tools, it was decided to continue with the use of traditional technologies such as Moodle Group Support System, and communication technologies such as Skype and various e-mail and chat programs. The experience of GCB's first year shows that the international teams were able to establish collaborative practices using these technologies. However, while these technologies were adequate for establishing small scale collaborative information and data interchange, a more stable and scalable platform would be needed for large scale collaborations (such as is the case with the two hurricane projects). Thus it would be useful to get SAGE and its associated collaborative platforms up and running for the second year of the GCB program.

Conclusions and recommendations

These appear throughout this report. However, three important ones stand out:

Collaborative groups need to have a task with a scope and technical requirements they can control, and communication technologies commensurate with the task. The two groups for which this was the case were very successful, the others were less so.

The most important single ingredient for GCB's successes in its first year is probably Dr. Masoud Sadjadi's teaching and science skills, dedication, ability to learn from the collaborative process, and effective facilitation of communication. If GCB is to provide a path for other global cyberinfrastructure collaborations, his contributions have to be formulated into procedures that can be learned by people in his position in future projects who might not come with the same level of skill and dedication that he has.

For a project like this to work on a global scale, international issues involved in communication, collaboration, and technology, have to be explicitly addressed in all aspects of the project, large and small, continuously. Where these require travel, it has to be facilitated.

Notes

1. http://www.cs.fiu.edu/~sadjadi/
2. Computer Network Information Center, Chinese Academy of Science, Beijing
3. Xing Hang, David Villegas Castillo, S. Masoud Sadjadi, and Heidi Alvarez. Formative assessment of the effectiveness of collaboration in GCB. In Proceedings of the International Conference on Information Society (i-Society 2007), Merrillville, Indiana, USA, October 2007 (accepted for publication).
4. Pallof, Rena M. and Keith Pratt, 2007. *Building Online Learning Communities: Effective Strategies for the Virtual Classroom*. San Francisco: Wiley.

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