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A Virtual Educational Exchange: A North–South Virtually Shared Class on Sustainable Development

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Abstract

Increasingly international competence is considered and important skill to be acquired from an undergraduate education. Because international exchange presents a challenge to many students, there is a need to develop and implement alternative means for incorporating international and cross-cultural experiences into the undergraduate classroom. We report on the implementation of a semester-long, virtually-shared course offering between a U.S. and a Bolivian university. Since STEM (science, technology, engineering and mathematics) majors tend to be under-represented in study abroad programs, this class sought to provide a multidisciplinary experience that could be relevant to both hard and social science majors. Furthermore, the relevance and learning impact of this class was enhanced through the incorporation of a service-learning component in conjunction with a rural Bolivian partner organization. The results of this experience show that virtually-shared class-room experiences can successfully facilitate international experiences for undergraduate students.

Keywords: virtual education; international exchange; service learning; global citizenship; STEM education; sustainable development

1 Introduction

The world is increasingly global: revenues of multinational corporations exceed the GDP's of medium-sized nations; high-speed communication is overcoming physical distances; overseas resources and global environmental constraints often dictate local economic trends. There is a recognition in the US and abroad of the importance of graduating students with "global competencies". Whether the focus is on ability of graduates to compete in the global market-place (National Research Council, 2007) or whether it is on students' preparation for understanding and tackling complex, multidisciplinary challenges such as global poverty and sustainability (Bourn & Shiel, 2009; Chan & Fishbein, 2009; Nieusma & Riley, 2010; Osler & Vincent, 2002), there is consensus about the need for graduates who can function in an interconnected, dynamic world.

The "global competence" called for is a challenge to impart in a traditional classroom setting because it encompasses a broad range of both traits and skills (Deardorff, 2004). Definitions of global competence typically recognize three key areas: attitudes (i.e. respect, openness, curiosity), knowledge (cultural understanding, language) and skills (effective communication, appropriate behavior) (Deardorff, 2006; Hunter, 2004). A "global citizen" has an understanding of a broader international context and combing competence in the aforementioned areas to operate effectively in multicultural and international settings.

Although scientific disciplines have historically emphasized technical skills, few areas are now feeling the influence of global forces stronger. Scientists are more likely than ever to work in international collaborations, and international co-authorship and co-patenting is on the rise (Freeman, 2010). Large scientific undertakings such as the Large Hadron Collider and the human genome project are multinational efforts. The solutions to many pressing questions of sustainability, from clean energy to water conservation, will require scientists to work not only across boarders but in multidisciplinary teams, taking into account a range of human and social factors. This call for globally competent scientists is reflected in many of the ABET 2000 engineering accreditation criteria: 3c,3d,3f,3g,3h,3i, and 3j (ABET, 2000).

Study abroad is often seen as the cornerstone for the acquisition of global competence, and research indeed

indicates that the positive gains range from intercultural skills (Clarke, et al., 2009; Williams, 2005) to language (Freed, Segalowitz, & Dewey, 2004; Kinginger, 2008). However, only a small fraction of US undergraduates study abroad – about 14% of students pursuing bachelors degrees study abroad at some point during college (Institute of International Education, 2011a). Of the students who do go abroad, STEM students are under-represented. In 2010, STEM majors (excluding social sciences) accounted for only 13% of students studying abroad (Institute of International Education, 2011b), even though approximately one third of undergraduates major in STEM fields (NCSES, 2010).

Barriers to study abroad include expense, difficulty of transferring credits, and a reluctance to leave friends and familiar surroundings (Parkinson, 2007). STEM majors in particular are characterized by large numbers of required classes and strict course sequences that discourage study-abroad. The challenge of curricular constraints are supported by studies such as (Salisbury, et al., 2008; Stroud, 2010) showing that the proportion of STEM students who as freshman express the intention to study abroad is significantly higher than the proportion who actually do so.

The Internet, one of the causes in the globalization revolution, may also provide a solution. With the rise of Internet video-conferencing, social networking, etc. an international experience is available to everyone. There is great potential to harness this medium in support of global learning. With virtually-shared classes, students can have the experience of working with peers in other countries without leaving their campus. Such programs, moreover, offer a great potential for scale-up. Once the infrastructure is in place, the incremental cost per additional student is relatively low (as opposed to, say, scholarships for study-abroad). Furthermore, it is possible to have long-term (full semester or longer) interactions without the need to take "time out" of a regular course of studies.

We report here on the implementation of a virtually-shared undergraduate class, *Rural Sustainability in Latin America (RSLA)*, which was offered for the first time for students at the Universidad Privada Boliviana (UPB) in Cochabamba, Bolivia and Siena College in New York in the spring of 2012. The class was designed to achieve the following: 1) provide a course offering appropriate to both science and social science majors where students would work in multidisciplinary teams, 2) to provided an intercultural experience where, through collaboration in international teams, students would interact with peers from a different country, 3) employ active learning and service learning methodologies where students learn through working on real-world projects and applications, 4) support sustainable development through service-learning.

2 Educational Foundations

In designing the virtually-shared course offering *Rural Sustainability in Latin America* (RSLA), we sought to capitalize on the proven benefits of active, problem-based and collaborative learning methodologies. The conceptual and scholarly foundations are summarized in Figure 1.

Problem-based learning approaches, emphasizing individual student responsibility for addressing tasks and solving problems, has gained recognition for a range of positive educational outcomes such as improved comprehension and retention of information (Allen & Duch, 1996; Barrows, 1996). Collaborative learning methods, relying on the active exchange of ideas within small groups, has been shown to promotes critical thinking in individual participants, with the entire cooperative team achieving at higher levels of thought than learners who work quietly as individuals (Johnson, Johnson, & Smith, 1998).

Collaborative and problem-based approaches are employed (often in combination) inside and outside the classroom in programs ranging from discussion-laboratories in the physics classroom, to formal student research experience programs, to student-run endeavors such as Engineers Without Borders (EWB). Both pure science and service-based learning have been shown to be valuable for promoting learning, scientific understanding and enthusiasm for the sciences (for instance, Astin et al., (2000); Bielefeldt & Pearce, (2012); Eyler, Giles, &

Braxton, 1997; Lopatto, (2004, 2007); Pearce, (2006); Russell & Hancock, (2007); Sax & Astin, (1997); Thiry, Hunter, & Laursen, (2011)). In particular, extra-curricular involvement in science-based projects has been shown to increase not only technical skills, but intangible assets such as self-confidence and self-efficacy, and skills both technical (such as lab skills) and "soft" such as teamwork and communication (Sadler, et al., 2010).

3 Review of the literature on virtual international course offerings in STEM

It is clear that there is a need to integrate global experiences into the traditional course of study. Though novel study-abroad programs, in particular exchanges of shorter duration, such as "field-trips" abroad and service-learning trips, are increasing opportunities for international experience, there is far to go before all or even a majority of STEM majors study abroad (Parkinson, 2007). Reliance on international travel as the sole means of providing global learning, implies that a large group of students will necessarily be left out.

Although the last decade or so has seen the implementation of a number of programs for virtual global learning, we remain in the early stages of such efforts. Though a large fraction programs have a business or humanities focus (see Hu, 2010 for a review), we focused on reviewing science-based classes to inform the design of RSLA. There is actually a relatively limited number of examples to be found. Though not exhaustive, the programs described below constitute a representative sample and demonstrate varying degrees of synchronization and coordination among participants.

A noteworthy program described in Rutkowski, et al. (2008), in implementation for over 10 years, involved business and engineering students from the Netherlands, Hong Kong, China and the US. Virtual teams build websites on software topics later compiled into a full-class final product. Most of the work was done asynchronously, with videoconferencing at the beginning, midpoint and end of the course. In another example, "virtual student exchanges" were used in a computer science sophomore design class (Doerry, et al., 2004), with students interacting almost exclusively via email. The authors report the international collaborations to have been weak, with students engaging in the minimum interaction necessary to complete the assignments and communications to dwindling over time. They conclude that the course would have been improved by synchronous interaction and restructuring of the projects. Similar conclusions are reached by the coordinators of the Multidisciplinary International Virtual Design Studios (MIVDS), implemented in the context of a capstone design class (Erden et al., 2000). The authors note that in addition to supporting synchronous collaboration, a physical visit can be helpful for creating group cohesion.

The literature on classes run and refined over a number of years indicates that effective international collaboration requires both synchronous and asynchronous collaboration, carefully crafted projects and instruction directly addressing aspects and tools of international collaboration. For instance, recommended practices refined during 10 years of running an IT and Society course administered jointly by Swedish and US universities include: sessions with a cultural awareness expert to promote trust-building, assigned reflections on the value of the international collaboration, selection of projects in areas of high social relevance, and the provision of an external mentor for each group (Daniels, Cajander, & Pears, 2010). These findings match those reported by Cogburn, et al., (2010) in their work evaluating a decade long experience running cross-national graduate seminars.

Though these programs demonstrate the potential the Internet provides for international learning, there is much room for growth. Programs are largely isolated experiments at a small number of universities and further exploration of specific techniques and best practices is needed. Importantly, STEM programs found in the literature tend to have an engineering and/or information systems focus whereas other areas such as physics, math, environmental science, etc. have been untested when it comes to virtual cross-national learning.

4 Supporting Sustainable Development in Bolivia

The UN has declared 2005-2014 the "Decade of Education for Sustainable Development" (United Nations, 2002) with the overarching goal of "mobilizing the educational resources of the world to help create a more sustainable future"(UNESCO, 2013). This resolution embodies the idea that education plays a complex and multifaceted role in supporting development that exceeds the goal of improving education in developing nations. It recognizes the relationship of education to sustainable development through research, academic programs and the creation of globally aware, sustainability conscious citizens (Lawale & Bory-Adams, 2010).

RSLA is a contribution to efforts in education for sustainable development while the subject is a good fit for the class structure. The problem-based teaching methodologies espoused are widely acknowledged to be a preferable way to teach sustainability issues (Lehmann, et al., 2008; Pearce, 2006). Sustainability is interdisciplinary by nature. As stated in the NSF *Science, Engineering and Education for Sustainability* initiative, "Fundamental to all sustainability research is the simultaneous consideration of social, economic, and environmental systems and the long-term viability of those systems" (NSF, 2012). Thus, course offering in sustainable development can be relevant to a wide variety of both hard and social science majors. Finally, the knowledge-base for global competence and sustainability is complimentary. Global competencies are necessary for successfully engaging in sustainable development (Mihelcic et al., 2008) while at the same time a knowledge of sustainability and development issues is important for creating global understanding.

RSLA is far from being the only effort to combine education for sustainable development and global competence. One well-known example (of many) is D-lab program at MIT (MIT, 2013) that currently encompasses 12 course offerings on sustainable development where students work development projects in a classroom context. Extra-curricular organizations such as Engineers Without Borders are also gaining great popularity. EWB, for instance has grown from 5 to 180 student chapters (12,000 members) since its founding in 2002. Though these university programs are an exciting way to both contribute to development efforts while at the same time educating students about sustainability and international issues, a major challenge lies in maintaining successful collaborations with local partners in the developing world.

Development practitioners have often discussed the importance of intermediate partners who can serve as a cultural bridge between the developed nations and the target populations while at the same time being empowered to enact positive change in their own country (Carroll, 1992; Polak, 2008). Ideally, in a virtual course such as Rural Sustainability in Latin America, the Bolivian students in the class can act as the intermediate partners for US student groups engaging in development projects in Bolivia. Although Bolivian students may not be directly involved in the communities towards which the project is directed, unlike professional employees of NGOs, they share similar academic priorities and constraints as their US virtual classmates. Additionally, Bolivian university students have a much greater access to Internet and communication, making regular interaction much easier that it is with rural partners. Bolivian students, therefore, may be ideally situated to be cultural ambassadors for their US partners.

On the other hand, a virtually-shared course-offering embodies equity espoused, but not actually practiced, in course-offerings on sustainable development. In RSLA, Bolivian students are equal participants and benefit directly along with their US counter-parts. The need for increased international experiences is arguably even more essential for Bolivia. With approximately half the population living below the poverty line (The World Bank, 2013), and the average urban salary less than $300 per month (Instituto Nacional de Estadistica, 2011), international travel is economically prohibitive to a large portion of the population. Only the wealthiest fraction can afford a study-abroad experience without scholarships or other external support. Additionally, the Bolivian university system more closely resembles a European model where students have fixed requirements each semester, few electives and little flexibility when it comes to taking courses out of order. These factors collude to make study-abroad extremely difficult for Bolivian students.

The empowerment of Bolivian students is also a compelling aspect of a shared course offering. Even well

intentioned development programs originating in economically developed countries run the risk of creating a cycle of dependency and/or inferiority, where local partners lack ownership of the development process (Arunachalam, 2002). By engaging Bolivian students as equal partners such tendencies can be potentially counteracted. Even if a the student-run projects themselves may lack development impact, a joint class achieves the worthy objective of sharing the educational benefits with the developing nation. Moreover, Bolivian students living in urban areas can be as disconnected from rural poverty as US students are, both in the US and abroad. The experience of working on service-based projects with US collaborators, can inspire and empower these students to continue to work on development issues in their own country.

5 Rural Sustainability in Latin American – Course description

The goal of the virtually-shared class *Rural Sustainability in Latin America* (RSLA) was to capitalize on the improved learning outcomes of problem-based and collaborative approaches to teach concepts of sustainability while at the same time providing a meaningful international experience to the students involve. The course was designed to involve US and Bolivian students equally, and an emphasis was placed on creating a class structure such that discussion, interaction and engagement with international teammates was an integral part of the course.

5.1 Participating institutions

The initial concept for the course arose out of an informal meeting between the director of the Office of Academic Engagement (ACE) at Siena College and the first author of this article, a professor at UPB. Students participating in the Bonner Program administered by ACE, spend 4 years involved in structured community service activities. In the third year of the program, students are required to volunteer for a summer in a developing country (India or Bolivia). Faculty at Siena wanted to both improve students preparation and deepen the intercultural exchange by providing interaction prior to travel. At the same time, Bolivian faculty under the UPB president's challenge of "internationalizing the university" were eager for ways to incorporate international experiences into the classroom.

With service being a priority for ACE participants, a problem-based learning component was devised around service projects in rural Bolivia. Both the UPB and Siena College had prior ties to the Unidad Academica Campesina (UAC) in Carmen Pampa, Bolivia, a rural university in the high jungle region near La Paz that provides university degrees to low-income students from primarily rural areas. The UAC suggested problem areas in which student projects could benefit their campus. Although internet limitations meant that students at the UAC could participate directly, students at the UAC could provide support through answering questions and providing local information relevant to the projects.

The course involved various professors: two (one from the UPB and one from Siena) served as the primary coordinators and were present in all the classes and were responsible for grading and course administration. Two more professors (one from the UPB and one from Siena) assisted with planning and coordination of the course and were often present in class. Five additional professors contributed with lectures on relevant course topics related to their specific area of research. For instance, the director of the Center for Globalization Studies at Siena College presented on globalization, an expert on water resources lectured on sustainable water management, an expert on forests discussed ecotourism, woodlands and development. Beyond creating the lectures and discussion questions, however, these experts were not directly involved in managing other aspects of the course.

5.2 Course structure

The virtual course called "Rural Sustainability in Latin America" was offered as an elective at Siena College, although it was required for students traveling to Bolivia in the Bonner Program the following summer. At the UPB, students are already required to take "Ethics" and "Sustainable Development", both short two-credit

classes. The virtual class was offered as "Desarrollo Sostenible y Responsibilidad Social" and enrolled students could either opt to fulfill these two requirements or else take it as an elective.

As demonstrated in the literature-review, the most successful virtually-shared classes have involved both synchronous and asynchronous interaction. Accordingly, the class was conducted in a blended format with both shared full-class lectures, chat-sessions for work in small groups and assignments for asynchronous discussions The Bolivian-US shared classes ran concurrently for 12 weeks during the spring semester of 2012 and met bi-weekly. 25 students enrolled in the class – 16 Bolivian and 9 US – and were drawn from a range of majors. On the Bolivian side, majors included Economics, Systems Engineering, Petroleum Engineering, Communication and Business. On the US side majors included Environmental Science, Environmental Studies, Sociology and English. Typically one day a week was devoted to lecture and one day a week was devoted to work in small groups. Outside of class, students interacted asynchronously through a class wiki and a discussion forum.

5.3 Course content

RSLA was designed to provide both a theoretical and a practical component. The theoretical component was divided in three units: 1) introduction to development in a global context 2) sustainable resource management 3) development actors. The first unit focused on social and economic theories of development and on external factors such as globalization. The second unit introduced issues in the management of natural resources (energy, water, land, etc.) in the context of rural development. And the third unit briefly touched on important actors and stakeholders in sustainable development (local communities/governments, NGOs, socially-responsible businesses, etc.)

The practical component of the course consisted of group work on projects. The students were divided into 5 multi-disciplinary teams with members from both countries. Each team was assigned a problem in one of four areas relevant to the needs of the UAC: 1) Waste/trash management at the UAC and in the surrounding community, 2) development of ecotourism at the UAC, 3) liquid and solid wasted treatment from a small pig farm on the UAC premises 4) evaluation of alternative energy options for the UAC. Each group was responsible for researching solutions and creating a report proposing one or a combination of recommendations for the UAC.

5.4 Lectures

Lectures were given by the coordinating professors and guest lecturers from both the UPB and Siena College on topics relevant to the course material. Classrooms at the UPB and Siena were outfitted with a computer, a web-cam, microphones, speakers and a projector. Students physically attended class in their respective countries, while the two locations were linked using Webex software. Webex enables not only video-conferencing capabilities where each class could hear and see their international counterpart, but also allows lecturers to load and project their slides at both locations.

Coordinators were always present to facilitate by calling on students, passing the microphone and encouraging participation. This set-up enabled students at both locations to be actively engaged in class discussions even when the lecturer was physically located in the other country. A US lecturer, for instance, might ask the Bolivian students their opinions on a Bolivia-relevant topic, or a Bolivian student might ask the US class a question.

5.5 In-Class Group Work

On non-lecture class days, students were assigned group work. Early in the semester they were divided into multi-disciplinary (based on major) mixed Bolivian-US teams and assigned a project relevant to the UAC. In initial sessions groups were given assignments related to lecture material, and as the semester progressed, group sessions were devoted to making progress on project-related assignments.

For group work students were asked to bring in personal lap-tops and the groups connected via Skype or another free video-conferencing software. Though it was initially hoped that students could talk in their small groups, in practice it was found that the bandwidth was insufficient for multiple groups to video-conference at the same time. Hence most groups ended up chatting.

5.6 **Asynchronous Interaction**

Students were also required to participate asynchronously outside of the class setting. The class was organized on a wiki hosted by Pbworks. The homepage is captured in Figure 2. Students initially created individual profiles on the wiki, and early assignments included introducing themselves and commenting on foreign classmates profiles. As the class progressed, student groups created project pages on the wiki where they submitted project-related assignments. The wiki environment, similar to a Google Doc, enabled students to log on and add to or edit pages created by their group members. Since the wiki automatically tracks edits, this additionally provided a convenient way for instructors to monitor group participation or easily give feedback to by making comments directly on the wiki pages.

Students were also prompted to discuss class readings outside of class. Initially questions were posed to them on a discussion forum. But this method was quickly found to be unwieldy and was abandoned in favor of a class Facebook group. This culturally lent itself better to student habits, especially since the Bolivian students tend to check email infrequently, but use Facebook assiduously.

5.7 **Assignments**

Students were assigned work to promote learning in three major categories: 1) to interact individually with the course material and readings 2) to interact with classmates in general on class topics 3) to work in a small group on an applied project related to sustainable rural development in Bolivia.

Individual assignments were primarily reading assignments and the completion of a weekly reading quiz that was administered online. The motivation of the reading quiz was both to require students to interact with the texts and allow lecturers to respond to student questions and misconceptions in the lecture itself.

Students were also assigned tasks to encourage them to interact as an entire class and across countries. An early assignment was for students to create a profile page on the wiki. They were then asked to comment on the profile of at least two classmates in the partner country. As noted above, students were regularly given discussion questions and prompted to participate in a discussion forum. To promote interaction, students were required to not only post to the discussion, but comment on classmates' posts.

The primary class assignment was a group project. Students were divided into 5 multidisciplinary teams consisting of 3 Bolivians and 2 US students (one group had 4 Bolivian and 1 US student due to the asymmetrical numbers). These groups were assigned a project in one of 4 areas related to specific needs and concerns of the UAC: trash-management at the UAC and in the village of Carmen Pampa, development of ecotourism options at the UAC, management of waste and runoff from a pig farm at the UAC and evaluation of alternative energy options for the UAC.

Students were assigned both individual and group work related to their project topic. As a group, students worked to define and divide their larger group projects into sub-areas that were taken on individually. Students were guided to develop sub-projects that were both interesting to the individual student and would contribute to the larger group product. Assignments were given throughout the semester to both promote teamwork and also to lead to a satisfactory final product. These included creating a group communication plan, assigning group roles, defining a group problem-statement, defining individual problem-statements, creating an annotated bibliography, creating questions to ask of our contacts at the UAC, writing a group section on background to

their projects, submitting paper outlines and finally analyzing their combined work as a group.

6 Faculty Assessment

Our principal method of collecting feedback on faculty/administrator views of the course is through the interview of the four primary instructors involved in the coordination. The interviews were conducted during Fall 2012 using an open-ended interview protocol (Patton, 2005) we developed.

6.1 Background of Faculty Interviewees

There are four interviewees, three of whom are female and one of whom is male. The two female interviewees teach in Bolivia; there is one male and one female interviewee from the U.S., one of whom is an administrator. With regard to rank, it is difficult to make comparisons due to the different system of titles in each country. Rather, it is useful to compare years of experience with the faculty in Bolivia presenting 12 years of teaching experience and 3 years of teaching experience as a regular faculty member on the Bolivian side and 7 years of teaching experience and 9 years of teaching experience on the U.S. side.

One faculty member in Bolivia had no prior experience with collaborative teaching, either on-line or face-to-face; the other had limited experience with team teaching in a face-to-face setting. On the U.S. side, both faculty members report experience with co-teaching either as a graduate student or as a faculty member.

6.2 Faculty Views Regarding Program Administration

On the Bolivia side, answers regarding getting approval from an administrator indicate that is was easy and that the administration was very positive about the project and the collaboration. Additionally, there was ongoing information flow. On the U.S. side, it appeared to be equally easy. There was an approval from the department head who was, indeed, a champion of experimental educational initiatives. Similar to the Bolivian experience, this administrator continued to support the project and get updates regarding its progress. Additionally, one interviewee noted there was 'paperwork' between the two schools as well.

6.3 Faculty Views regarding Barriers

No interviewee identified administration as a barrier. Both on the U.S. and Bolivian sides, faculty highlighted technology as being the factor that most hindered collaboration. Both Bolivian and U.S. interviewees felt there was a need for better technical support. (These findings parallel other studies of technology-based collaborations, especially in their initial years.) Another perspective related to this barrier was one interviewee's comment that it was a "challenge to be responsible for the technology as well as the class." In addition to technology and technology support (its absence!) serving as barriers, interviewees also identified "lack of bonding between the groups from each school at the beginning. Again, findings from related research indicate that this is a common occurrence, unless there is early intervention. Additional barriers noted by at least one respondent include: the large time-demand on the part of the coordinators and the presence of slightly different faculty visions for class/learning goals.

Another set of hindering factors focused on differences among the student groups themselves. There were differences in level of involvement/engagement with the collaborative class on the part of the students, the faculty may have been uncertain as to how strict to be regarding the completion of student assignments for both sides, and there appeared to be differences among the groups in terms of student motivation, with one group caring less about grades. These characteristics, in turn, resulted in the best students being frequently frustrated and hindered the quality of group work. There were also cultural differences noted, with Bolivian students being seen as more shy about speaking. Finally, in the words of one interviewee, "geographic proximity favored co-located groups".

Turning to facilitating factors, faculty noted the positive role in the collaboration for 'students who were motivated and interested", the bringing together of all students at the end of the course, and the real-world projects on which the students collaborated. Additional facilitating factors related to the faculty and the administration: the flexibility of the faculty who worked on the collaboration; "the goodwill on both sides"; "mutual interest" on both sides; and the encouragement of the administration regarding the project.

All of the interviewees in their independent interviews agreed that the learning outcomes were greater than those in a regular classroom. They named " intercultural outcomes" and "learning to use technology to facilitate discussions and projects" as key factors.

7 Discussion of specific methodologies and technologies employed

7.1 Technology

The performance of communication technology was a critical factor in the success of the course. Though faculty observed that technology was a source of frustration, many of the tools implemented performed satisfactorily.

Internet Connection

The biggest limitation, was perhaps the Internet bandwidth at the UPB. In Bolivia, bandwidth is approximately 20 times more expensive than it is in the US (approximately $80 for a 1 Mb/s monthly). And even at that price, the connection is easily saturated and unreliable.

The UPB was able to dedicate a 1 Mb/s connection for class use. Though it was generally adequate for lectures, it was insufficient for group work where multiple teams sought to connect simultaneously via separate video-conferencing sessions. When given an opportunity for group work during class, students were forced to use chat (without sound or video) so as not to saturate the connection.

Equipment and facilities

The audio-video equipment used for lecture was for the most part adequate. The Webex supported all the functionality necessary (seeing/hearing the other class, lecturer and presentation). Webex also has a built-in white-board, although neither side had set-up with a tablet/pen to make this feature convenient to use.

Although both classes experimented with omnidirectional microphones, in the end we opted for hand-held wireless microphones. One was typically used by the presenter while a second was passed between the students for comments and questions. Though some time was used to change speakers, this set-up had the advantage that it made the speaker easily identifiable to the class viewing them remotely via web-cam.

At both the UPB and Siena, classes were held in conventional classrooms equipped with the projector, computer, webcam and microphones necessary for the virtual sharing. Once again, these facilities worked well for shared lectures, but were not as adequate for work in small groups. Student groups had limited space in which to spread out and often found their communication drowned out by the noise of competing conversations.

Software and Communication Technologies

Rural Sustainability in Latin America utilized a number of communication technologies (a wiki, a discussion forum, a Facebook group and the *Quaterics* survey system) for virtual collaboration outside of class. For the most part, they worked well for their intended purpose.

The wiki, hosted by Pbworks allowed students to work on project pages and documents remotely. There appeared to be a bit of a learning curve for getting started and being able to edit documents and pages, but nothing that prohibited participation long-term.

The Quaterics system allowed students to respond to reading quizzes remotely. The instructor, via a separate link, could then log in and see all the answers submitted. This allowed lecturers to address questions and misunderstandings during class. The only inconvenience is that administration of the system was limited to the instructors at Siena who had access to the technology through their university. In a future implementation of the course, it might be desirable to explore free services such as *Survey Monkey* or *Zumerang* that could provide similar functionality.

The only technology tried that was found to be inadequate and quickly discarded was the forum hosted by Leforo, initially used for full-class virtual discussions. After difficulties registering all the enrolled students in the forum and inserting in the wiki, it was found to be unwieldy and inconvenient to check on a regular basis. Students unanimously voted to migrate class discussions to a Facebook group. Instructors, meanwhile, being confident that students were regularly checking a site where they could post comments and announcements.

7.2 Course design

Rural Sustainability in Latin America was designed with an ambitious amount of collaboration: 100% shared content. Although this required a high degree of coordination on the part of participating faculty, it resulted in a fully shared experience on the part of the students. Both sides had a true taste of the academic culture and expectations of their counterparts. Needless-to-say, this was not always without frustration that stemmed mainly from two interrelated cross-cultural components: faculty from the two different cultures collaborating on the course design and implementation and the different institutional and national cultures represented by the students. However, the fact that these differences were felt and noticed, speaks to the fact that students were forced out of their comfort zones through the high levels of interaction. Having Bolivian and US members in the same groups, although at times a challenge for these students, necessitated cross-cultural interaction and was an important component of the course offering. Though this is a feature to retain in a future implementation, it would be beneficial to experiment with ways to improve cross-cultural aspects of the group interactions. Ideas include having an introductory class entirely devoted to inter-cultural and group communication and regular meetings with a (faculty or advanced student) mentor, trained in both the subject matter and in cross-cultural teamwork. (See, for example, Cogburn and Levinson, 2008, for a similar finding of cross-cultural communication challenges in U.S.-S. African student virtual teams and a recommendation for instituting cross-cultural training at the beginning of coursework.)

Thus, further offerings need to build in faculty cross-cultural communication awareness prior to design as well as cross-cultural communication (and related trust-building) learning exercises at the start of the class. Ideally, future offerings could use a pre and post test on-line faculty and student survey to measure baseline awareness of cross-cultural communication and of cross-institutional trust.

A final action item for future implementation is overall streamlining of the course: eliminating any guest lectures not linked directly to student projects so as to maximize active learning and strengthen the curricular links between the theories presented and the students' projects.

8 Conclusions

This article focuses on the first year of this cross-national virtual collaboration initiative, that succeeded in achieving a high level of synchronization between Bolivian and US classrooms. Both hindering and facilitating factors stemming from this first year experience were identified. These clustered around the following three categories: administrative support/champions; technical support (or the lack thereof); cross-cultural communication factors (absence of early cross-group bonding and differences in learning styles); time investment of faculty; and curricular design issues and opportunities. Suggestions for improvement include using better,

more reliable equipment and providing technical support throughout; making sure the students understand the learning objectives early on; learning cross-culturally about different modes of discussion; keeping the assignments simple; incorporating more discussion and more active and discovery-based learning; and clarifying a lead role so that there would not be too many faculty cooks at the beginning. Improved mentoring of student groups could also be beneficial, and a future rendition of the course could explore recruiting students from prior courses to serve as peer mentors and role models.

The implementation of Rural Sustainability in Latin America, demonstrates the potential for positive international learning via virtually-shared classroom experiences. With the increasing demand for globally competent citizens, this example can provide a model for providing international experience through virtual classroom exchanges.

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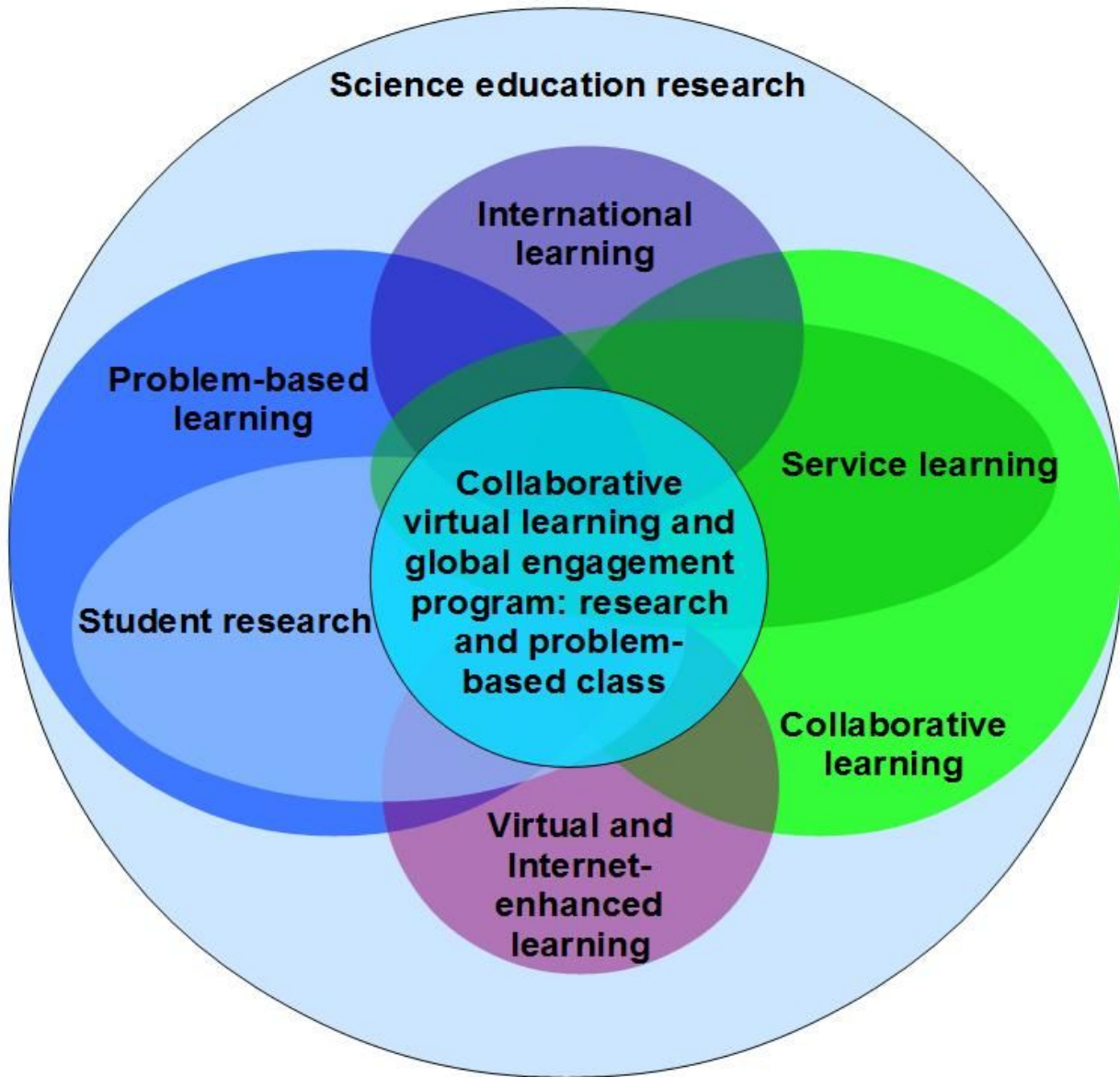
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Figure 1: Educational context for the C-VILAGE program.

Figure 2: The front page of the class wiki. Tabs link to schedule, syllabus, projects, etc. A list of changes to the wiki are tracked in the panel on the right. In the project section, each team created their own project page which they worked on as a group.