Future Learning Landscapes: International Agroecology Education and Outreach through Online Social Networks and Geographic Information Systems

A Thesis
SUBMITTED TO THE FACULTY OF
UNIVERSITY OF MINNESOTA
BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OF SCIENCE

Dr. Paul M. Porter, advisor

June 2014

Acknowledgements

I am thankful for the advising of Drs. Paul Porter, Nicholas Jordan, and David Pitt in the preparation of this thesis. Their guidance was essential.

Dedication

This thesis is dedicated to my wife, Jennifer Runck.

Abstract

Chapter 1: Given that much of the learning about international agroecology would ideally occur outside the classroom, Adventure Learning (AL) and Systems Action Education (SAE) can offer synergistic approaches that synthesize these methodologies into a cohesive student learning experience. This paper reports on the evolution of a series of international agroecology courses offered from 2009 to 2011 that progressively integrated AL and SAE approaches in course design. The courses were taught by a University of Minnesota professor as he bicycled across Africa (2009 and 2010) and South America (2011), exploring various landscapes, crops, climatic regions and food systems with students back home via distance technologies. End-of-course survey responses indicated that students 1) did not find the course any more rigorous than similar level courses, 2) found the course much more unique ($p < 0.01$), and 3) increased their desire to travel abroad ($p < 0.01$). Our examination also revealed challenges and opportunities inherent with AL and SAE–merged classrooms. Overall, we found that AL and SAE approaches could be integrated to enhance agroecology education and can make courses inspiring, challenging, and rewarding. The result could have implications for schools that seek to prepare students to work in a global environment.

Chapter 2: In response to calls to further synthesize Systems Action Education (SAE) and Adventure Learning (AL), a new action education framework is presented called the Extended Classroom Framework (ECF) for teaching systems of analysis of food systems. ECF integrates SAE and AL with the Circulatory System of Science (CSS) to describe how the experiential classroom interacts with society. In the fall of 2012, the ECF was

utilized to design a hybrid course (e.g. half face-to-face, half online) at the undergraduate level that explored four different international agroecoregions through the perspective of on-the-ground collaborators. By utilizing online geographic information systems and an online social network, students digitally explored the agroecosystems as open-ended cases with the guidance of the local collaborator. A pre-test and post-test of the Intercultural Development Inventory and the New Ecological Paradigm survey were given to the students. Students also wrote four reflective journals throughout the semester that were coded and thematically analyzed. 85.5% of students showed significant positive shifts individually in the developed orientation ($p < 0.05$). Additionally, four out of seven students showed significant decreases in their intercultural orientation gap. Every student ended the course similarly or less culturally disengaged to a primary cultural group, with 85.7% of students in the resolved category, which compares with 57.1% at the beginning of the course. NEP Survey had a poor response rate, and was statistically insignificant. Student reflective journals illustrated growth in considering agroecosystems contextually and as coupled human-environmental systems. These results show that the ECF offers a viable framework for developing student capacities to engage wicked problems.

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Introduction

This thesis can be conceived of as a call and response. In Chapter 1: Agroecology Education by Bicycle on Two Continents: Student Perceptions and Instructor Reflections, I argue that Systems Action Education (SAE) and Adventure Learning (AL) are synergistic frameworks of undergraduate education based on a set of three courses describing an AL project performed at the University of Minnesota from 2009 to 2011. These courses involved an adventurer traversing two continents by bicycle to be the eyes, ears, nose, mouth, and feet of undergraduate students exploring agroecology in Africa (2009 and 2010) and South America (2011). The call at the end of this paper is for a more cohesive framework to be presented that fully integrates SAE and AL.

The response to this call is Chapter 2, which develops a theoretical framework titled the Extended Classroom Framework (ECF) that merges AL and SAE with the Circulatory System of Science (CSS). The result is a framework that not only describes the activities that occur within the learning environment, but also describes how the agroecology classroom interactions with broader society through action learning. The addition of CSS provides the general categories of society that the action classroom should include if they desire to present a full range of social perspective for students. Cautiously optimistic, the intended result is not only students learning from real-life people, but also real-life people learning from students. The end result, hopefully, is an extension of individuals' empathetic capacity to not only broader humanity, but also to ecosystems so that management is done fully engaged with hands, heart and head.

Chapter 1: Agroecology Education by Bicycle on Two Continents: Student Perceptions and Instructor Reflections

INTRODUCTION

Adventure Learning (AL) and Systems Action Education (SAE) are education models that seek to bring authenticity to learning environments by facilitating learners' interactions with real-world systems and problems. To date, there have been few explorations of AL in a small-scale context (i.e. a small class size and low budget context) (Veletsianos and Kleanthous, 2009; Veletsianos, 2010), and none have explored food systems education. AL is "a hybrid distance education approach that provides students with opportunities to explore real-world issues through authentic learning experiences within collaborative learning environments" (Doering, 2006). AL emerged in the 2000's as a way to allow students to connect to complex global issues such as climate change in an experiential way via online technologies where an adventurer serves as students' guide. The goal was to connect students to issues, by bringing them to real places, engaging more of their senses and thus making learning more impactful. Systems Action Education emerged from the realm of food systems education "as a method to inform the design of curricula" that "assist(s) learners in gaining special orientation and practical capabilities that appear crucial to management, stewardship and sustainable development of agriculture" (Francis et al., 2012). While SAE has been implemented in an online context, it currently lacks the explicit instructional design framework that AL offers. This paper reports on a small scale project involving University of Minnesota

students and faculty that evolved to integrate strengths of both educational approaches. Each successive year from 2009 to 2011, the teaching and learning experiences incorporated the AL (Doering, 2006) and then the SAE (Francis et al., 2012) approaches more comprehensively.

In 2009, 2010 and 2011 a series of focusing on international food systems was offered through the Department of Agronomy and Plant Genetics at the University of Minnesota (Francis et al., 2011). Dr. Paul Porter, a professor in the College of Food, Agricultural and Natural Resource Sciences, bicycled across Africa in the spring semesters of 2009 and 2010, and across South America in the fall semester of 2011. During his travels, he remotely taught U of M undergraduate students enrolled in AGRO3480 (titled *Food and Agriculture from Cairo to Capetown at 10 mph* in 2009 and 2011, and *Food and Agriculture from Buenos Aires to Lima at 10 mph* in 2011). In 2009 and 2011, he received support from two teaching assistants (Margaret Wagner and Bryan Runck, respectively), and in 2010 and 2011 he co-taught with Dr. Mary Brakke, an instructor who remained in the classroom on campus. Course materials and daily updates were available online to students and to the general public. Additionally in 2011, Runck developed a K-12 curriculum that was made available online. Also during that course, three U of M undergraduates and one graduate student accompanied Dr. Porter, or, for our purposes, the "adventurer," on the ride.

Background: Adventure Learning and Systems Action Education

Adventure Learning, pioneered by Aaron Doering of the University of Minnesota through his *Go North!* Projects in the 2000's, inspired millions of learners globally as he dogsledded across the Arctic exploring environmental issues through a multidisciplinary lens focused on problem solving (Doering, 2005; Doering, 2006; Doering, Miller & Veletsianos, 2008). His work inspired students through the narrative of an adventurer as he explained the Arctic ecosystem, climate change research, and indigenous peoples' cultures. While Doering's efforts were overwhelmingly successful, critics of AL have stated that the large scale and high cost makes the approach elite and exclusive (Veletsianos, 2010). In response, the AL framework evolved to become more inclusive of small scale and even low-technology style projects (The Learning Technologies Collaborative, 2010). In their review of AL literature, Veletsianos and Kleanthous (2009) specified AL as an "*approach* [authors' italics] for designing teaching and learning environments, whether those are online or hybrid, or used in face-to-face or distance education contexts." This definition differs in many regards from the original learning technologies context that produced AL. The approach has evolved to encompass multiple project scales, however, it still remains grounded in experiential (Dewey and Small, 1897) and inquiry-based (Kolb, 1984) theory, where students are the center of the classroom experience. The goals of AL have also remained the same: authentic, context-specific education. Ultimately, the AL approach is flexible and able to be applied across disciplines and educational objectives. In our case, it offered a novel model for exploring agroecological inquiry online while remaining directly concerned with a specific place—the place that is the target of the "adventure."

There are many synergies between Adventure Learning's and Systems Action Education's theoretical foundations. In a recent publication, Francis et al. (2012) reviewed the agroecology education literature, presented a cohesive picture of the current theoretical thought within SAE regarding agroecological education, and laid out a path for the future of agroecological education. While informed by similar constructivists such as Dewey (1897) and Kolb (1984), SAE also has theoretical roots in Freire (1973) and Hahn (Carver, 1997). Freire and Hahn offer two educational approaches, both tied to empowering learners through authentic, capacity-building experiences. Francis et al. (2012) also articulated the importance of studying agroecosystems both "systemically" and "systematically." In other words, agroecological education should offer opportunities for students to shift back and forth between considering the individual elements of a system (systematic study) and the interconnected nature of these elements (systemic study). While AL does not overtly emphasize empowerment or systematic and systemic study, these ideas are not inherently antagonistic to AL's goals. Adventure Learning, as stated above, also falls within the constructivist philosophical camp and adheres to a similar intellectual lineage. So while some fundamental differences in focus exist between SAE and AL, these differences actually enhance areas currently overlooked in each model.

Agroecology has been primarily defined as a "systems thinking" and "trans-disciplinary" field concerned with "wicked" problems, or problems that elude disciplinary, single-

solution answers (Francis et al., 2003; Francis et al., 2012; Wezel et al., 2009). Because of the field's orientation toward applied knowledge, agroecological educational theory focuses on "capacity building" within real-world contexts that prepare students with the intellectual and practical skills to address wicked problems (Francis et al., 2011). Adventure Learning has similar concerns in terms of building student capacities (Doering, 2005). For a fuller comparison of SAE and AL, see Table 1.1.

Research Goals

In light of the synergies between SAE and AL, the University of Minnesota courses (AGRO3480: *Food and Agriculture from Cairo to Capetown at 10 mph* and *Food and Agriculture from Buenos Aires to Lima at 10 mph*) evolved to more fully incorporate the constructivist and student-centered nature of both approaches. End-of-course surveys enabled the teaching team to retrospectively characterize the impact of each approach. We sought to test the combined effectiveness of AL and SAE in the following ways:

- We wanted to document whether AL could be an effective pedagogy for agroecology instruction by analyzing students' end-of-course, open-ended survey responses.
- Because of the evolving nature of the courses' use of AL and SAE, we wanted to compare the shifts from 2009 to 2011 in student perceptions of the learning experiences' rigor and uniqueness. We hypothesized that the course would be perceived as more rigorous and unique in 2011 because of the fuller integration of the two theories.

- Because of the heavy dependence on digital communication technologies, we wanted to compare students' perceived effectiveness of different content management systems (CMS) Ning and WordPress/WebVista, and use that information to inform future decision-making about CMS selection within AL and SAE classrooms.
- Because much of the interaction with the adventurer occurred via distance technologies, we wanted to document the impact of altering the course pedagogy from 2010 to 2011 on students' perceptions of the adventurer by coding short-answer survey responses.
- The U of M's College of Food, Agricultural and Natural Resource Sciences has become increasingly aware of the need to develop interculturally competent learners for work in a globalized economy. Because the instructors believed in the value of international experiences for undergraduates, we wanted to explore whether such a course would increase students' desire to travel abroad and engage in cross-cultural learning experiences.
- Finally, we wanted to document the rationale surrounding the shifting use of AL and SAE**,** and the resulting technological shifts, from the instructors' perspectives.

MATERIALS AND METHODS

When designing the three separate course iterations, aspects of AL and SAE were integrated at different levels. The general progression, however, was from teacher-centered to student-centered. For each course, the process began by selecting an issue and

a place to anchor instruction. In 2009 and 2010 it was ten African countries; in 2011, four South American countries. The main issue to be explored in all three courses was how humans alter their natural environments through agriculture, and how the natural environment influences human agricultural activity. These issues, while broad, were grounded in a specific set of topics for each country. These came about after reviewing relevant literature, then finding supporting multimedia and guest lecturers typically within the University of Minnesota who had expertise on the given subject, including politics, history crop production, etc. For example, in 2011, on the Argentina leg of the trip, the class studied changes in land use—how soybean production caused conflict through high exports taxes on soybean, and the move in Argentinian beef production to feedlot finishing. During this segment, students engaged in discussion exploring how global markets influenced land use change in Argentina, and how this land use change intersected with long-standing cultural traditions. To help students engage with the Pampas and the related issues, Dr. Porter called into class and discussed with students from the road to describe what he saw, and how what saw connected to these broader national and international economic and cultural movements. Dr. Porter posted pictures of the Argentine landscape, and different agricultural practices with detailed descriptions of each photograph. These photographs supported the weekly written blog posts and daily audio blog posts that Dr. Porter was posting online. Here is where the AL framework drives home the exploration of issue and place. It identifies the need for an authentic narrative, which was initiated by observations supplied by a professor biking through the

farms and markets of a continent and investigated further by students during discussions and in-class presentations.

Course design called for students on the University of Minnesota's St. Paul campus to follow the adventurer (Dr. Porter) as he bicycled across Africa (Spring 2009 and Spring 2010[*]) or South America (Fall 2011) (Fig. 1.1). Each ride coincided with the U of M's semester schedule (Table 1.S1). All three rides were organized by Tour d'Afrique (www.tourdafrique.com), which specializes in facilitating bicycle riders' travel on long-distance expeditions. On average, the adventurer bicycled approximately 100 km per day (Tables 1.S1 and 1.S2). For the African courses, he traveled with about fifty other riders on a fixed route through ten countries (Fig. 1.1; Table 1.S3). In South America, he traveled with about twenty riders (including four U of M students) through four countries (Fig. 1.1; Table 1.S3). Tour d'Afrique carried the riders' gear and provided local food on most ride days. In all three courses, there was a co-teacher and/or teaching assistant back in St. Paul delivering course content, coordinating logistics, organizing guest speakers, and managing the technology. Managing the technology consisted of constructing an online environment where students could pursue individualized investigation and consideration of agroecological issues that were identified by the adventurer.

Following the adventurer as he traveled cross-continent by bicycle and delivering high-quality instruction was complex. It required a variety of technologies, backup plans for

[*] During 2009, Prof. Porter spent half a semester teaching the course remotely before leaving Africa due to

backup plans, a well-informed and flexible base of support, and a willingness to be patient. In each successive year, adjustments were made to improve course delivery from a technical, logistical perspective. The goal was to design a learning environment in which students could utilize the adventure to pursue agroecological inquiry. As shown in Fig. 1.2 and Table 1.2, we continually tested and changed learning technologies to better meet student learning objectives. In 2009 and 2010, the content management system was WordPress and WebVista. At the time, it was University-sponsored and offered a relatively flexible way to host an online forum, and organize required readings and course assignments. After multiple discussions with Dr. Aaron Doering of the University of Minnesota Learning Technologies Laboratory, the team decided to move in 2011 to Ning (http://eatbikegrow.ning.com). Ning had the advantage of increased social networking capacity, customizability, and easy multimedia integration – all essential aspects of AL and SAE. The goal was to increase student and instructor social presence online, which was expected to increase the strength of the learning community and learner outcomes as described in the learning technology literature (Misanchuk & Anderson, 1996; Richardson & Swan, 2003; Kreijns et al., 2003; Annand, 2011).

Student interaction with the adventurer occurred primarily through daily audio blogs. Here the adventurer reflected on the food, agriculture, and agroecosystems he encountered. These mini-lectures, three-to-five minutes in length, were delivered from a satellite phone to the online audio recording system Hipcast (http://www.hipcast.com). From Hipcast, the audio blogs were transferred by a teaching assistant to the WordPress,

which facilitated media for the class in 2009 and 2010 in addition to course CMS. In addition, the adventurer periodically posted pictures with captions, written essays on various topics, and, in Fall 2011, short videos. The transmission of pictures and videos could only occur when there was internet capacity, which increased during this timeframe. However, when the trip took the riders into remote areas, students could wait four to six days for the adventurer's report. For a visual of the technological process and its evolution, see Fig. 1.2.

In addition to these communications, the course design called for guest speakers to present in the classroom on their area of expertise related to food, agriculture, climate, politics and culture in Africa and South America (Table 1.S4). The guest speakers, mostly faculty associated with the University of Minnesota, lectured on topics that related to the adventurer's current travel location. For example, when the adventurer was riding across the Pampas of Argentina in Fall 2011, Seth Naeve, a University of Minnesota soybean agronomist who spent considerable time doing research in South America, lectured on the agronomic and economic aspects of South American soybean production. In 2009, while the adventurer was scheduled to be in South Africa, a University of Minnesota faculty from the History Department students about decades of political events leading up to the presidential election, of Jacob Zuma. The timing of the election coincided with the study of South Africa. Overall, diverse speakers were important for engaging students' in systematic inquiry about agroecosystems, and stimulated students' systemic inquiry in small group discussions.

As the courses progressed, the teaching team realized the need to spend more class time emphasizing student-led and student-organized activities. In 2009 and 2010, in-class activities typically consisted of the adventurer calling in for the first fifteen to thirty minutes so students could ask questions and discuss what he was experiencing on the landscape. Student questions were based on course readings, listening to the daily audio blogs, and viewing images posted by the adventurer. The rest of the class period was devoted to the guest lecturers. In 2011, the adventurer still called in from the field first thing. But then, instead of only hearing guest lecturers, students would lead class discussions on a topic related to a specific location on the bicycle ride. In small groups, students identified questions related to a topic of interest then led class discussion. The activity enabled students to conduct their own inquiry based on questions related to observations provided by the adventurer or concepts presented by guest speakers. To round out course requirements, students were responsible for: 1) required readings posted to the CMS; 2) writing a report on a marginal crop (in 2011 they had to specify how the crop could be utilized to increase food security); and 3) finding a cultural experience related to the countries where the adventurer was traveling, such as eating at an authentic restaurant or attending a cultural event on campus. Students were then required to reflect on this experience and how it contributed to their understanding of the issues and places being explored in the course. The course also included a midterm and final exam that tested students' knowledge of course content as presented online and in-class.

The transition in instructional activity design from 2009 and 2010 to 2011 reflected the further expansion of the instructors' orientation toward not only the process associated with AL, where an adventurer tells a compelling educational story, but also toward the constructivist, student-centered nature of AL and SAE (Jordan et al., 2008; Francis et al., 2012). Systems Action Education particularly informed the design of the student-led discussions in 2011 that empowered students to explore the issues and places on their own terms (Table 1.2). Additionally, SAE was instrumental in informing the development of the cultural experience assignment, which required students to activate their learning in the unique cultural contexts within the greater St. Paul and Minneapolis area. The 2011 assignments were particularly designed to guide students in the exploration of various agroecosystems , both the individual components of food systems as well as the interactions of many factors that play out in both local and global context. This assignment, facilitated by multimedia uploaded by the adventurer, encouraged students to consider the details of food systems such as agronomic practices, local soils, and weather patterns (systematic study). It simultaneously encouraged students to consider the connections (systemic study) within the political and cultural systems, such as why food aid was present in countries with seemingly ample food.

The course was advertised at the university by flier, website, and through brief presentations in other courses. The 3-credit course was offered to any student wishing to take it, although the explicit expectation was that the workload would be most appropriate for an upper-level undergraduate. Additional assignments were required for

those enrolled as honors students or graduate students. Total enrollments are summarized in Table 1.S5. The general public was encouraged to follow along on the adventurer's WordPress website (http://paulporter.cfans.umn.edu) or the Ning website (http://eatbikegrow.ning.com). The trip also earned a number of articles in the popular press (Couzin 2009; Goulanger 2008; Gold 2011; Raveling 2011).

Student Surveys

From 2009 to 2011 (n=64), students were asked to take a course survey and rate the course and learning experience on a 0-10 scale, where 1=poor, 5=average, and 10=great, on the following topics: the course CMS, the adventurer's audio blog, enhancement of student desire to travel abroad, difficulty of course, uniqueness of course, and adventure's impact on student decision to take the course. The same survey asked students to rate course materials and activities (audio blogs, crop reports, cultural experience, Google Earth map, weekly quizzes, exams) on a scale of 1 to 4 (excellent, good, inadequate, very poor, and not applicable). In 2010 and 2011 the students were given a course survey designed by the University of Minnesota to rate the effectiveness of course instructors, and the course in general. The U of M survey asked students to consider instructor effectiveness and their own effort, and offered space for additional comments. Comments were coded for content and themes, and content dealing with students' perception of the adventurer were coded on a 10-point scale with 0=very negative, 5=neutral, and 10=very positive. Students were given surveys at the end of the course without the presence of instructors. The response rate was 81% averaged across

the three years. The list of questions and years asked appears in Table 1.S4. Pearson's Chi-Squared and Welch's t-test statistical tests were performed according to Snedecor and Cochran (1989) and Ruxton (2006), respectively, and were performed in the R Statistical Environment (R Core Team, 2013), with figures made using the ggplot2 library (Wickham, 2009).

Boxplots presented contain 75% of the data, with the horizontal bar inside the box representing the median. The bars represent data within 1.5 times the standard deviation of the data. Anything outside of 1.5 times the standard deviation is shown as a dot on the plots.

RESULTS

In 2009 and 2010, the student's perceptions of course rigor were on average 5.94 and 5.31, with standard deviations of 1.86 and 1.08, respectively. In 2011, the mean response was 5.58, with a standard deviation of 1.44. Across all years, the mean response was 5.71, or roughly average difficulty, with a standard deviation of 1.62 (Fig. 1.3). Each year, the courses were designed to be equivalent to courses of similar level and credit; therefore, we would expect an average response of 5. A Pearson's Chi-Squared Test revealed that the perceived rigor of the courses was not statistically different from the expected value for any of the years. Comparing pre-SAE (2009, 2010) and post-SAE (2011), the Welch's t-test, which accounts for the unequal sample size and variance, showed no significant difference in perceived course rigor. In other words, students

perceived the courses were average in difficulty when compared to similar-credit courses, and across years, the course was perceived to be similarly rigorous.

Across all three years, students found the course to be extremely unique with a three-year mean response of 9.17, and a standard deviation of 1.16. In 2009, the mean response was 9.11, in 2010, 9.43, and in 2011, 9.00, with standard deviations of 0.90, 1.09, and 1.81, respectively (Fig. 1.4). These results changed inversely with students' perceptions of courses rigor. A Welch's t-test revealed no statistically significant difference between years, but the results were statistically significant when compared to an expected response of 5, representing average, using a Pearson's Chi-Squared Test ($p < 0.01$).

In 2010 and 2011, the average course activity effectiveness, rated on a 1 to 4 scale, was 3.29 and 3.38, respectively. Coded student survey results between 2010 and 2011 reveal that in 2010, students emphasized their appreciation of the diversity of the guest speakers, but stated a desire for more time for discussion. For example, "I liked all of the speakers we had and felt very lucky to have them." In 2011, one student mentioned the desire for "more interaction with native peoples to share."

In 2009 (n=35), the mean response for the perceived effectiveness of the CMS was 6.97, with a standard deviation of 2.12, compared to a mean of 8.50 and a standard deviation of 1.51 for 2010 (n=16). When combined (n=51), the perceived effectiveness of the CMS was 7.45, with a standard deviation of 2.19. In 2011 (n=9), the mean response for the

Ning CMS was 5.75, with a standard deviation of 2.26 (Fig. 1.5). A Welch's t-test was used to compare the WordPress/WebVista and Ning. This revealed a difference at the 0.05 significance level between students' perceived effectiveness of the CMSs ($p = 0.03$) and a preference for WordPress/WebVista.

Additionally, in 2011 only, students were asked to rate the effectiveness of the Ning CMS as a way to follow the bicyclers. The mean response was 7.00, with a standard deviation of 1.65, which would indicate that students perceived the Ning CMS relatively positively as a method to facilitate communication between students and the bicyclers. In contrast, when students were asked to rate the Ning CMS as a means of facilitating student interaction with each other, the mean response was 4.75, with a standard deviation of 1.86, which indicates a slightly negative perception of the 2011 CMS in this regard.

In 2009, 74.29% of students visited the CMS one to two times per week, 22.86% visited three to four times per week, and 2.86% visited five times or more per week. In 2010, 50% of students visited the CMS one to two times per week, 50% visited three to four times per week, and no students visited the CMS five or more times per week. In 2011, 58.33% of students visited the CMS one to two times per week, and 41.66% visited three to four times per week. The most common number of visits per week on average over three years was one to two times per week, with 65% of students over the three years visiting the CMS that often, 33% visiting it three to four times per week, and roughly 1% percent visiting it more than five times per week.

Students perceived the course as increasing their desire to travel abroad. Students responded with a mean value across all years of 8.37, with a standard deviation of 1.88. There is some small variation across 2009, 2010, and 2011, with mean values of 8.17, 8.75, and 8.33, respectively, and standard deviations of 1.98, 1.65, and 1.97, respectively (Fig. 1.7). A Chi-Squared Test indicates that students percieved that they increased their desire to travel abroad each year, and combined across all years, as a result of the course ($p < 0.01$). A Welch's t-test indicates that there is no significant difference in this aspect between 2009 and 2010, and 2011.

A Welch's t-test of coded student comments revealed that they perceived the adventurer more positively in 2010 than in 2011 ($p < 0.01$) (Fig. 1.8). Specifically, the content of student responses in 2010 centered around the delivery of course content through both the designed course activities such as invited guest speakers, as well as adventurer interactions via web materials or satellite phone calls, which helped students understand the course content. Additionally, the 2010 comments showed that students perceived the adventurer as warm, welcoming, and engaged in the course. There was some focus in the comments on the task of bicycling cross-continent, and students expressed appreciation for the extreme nature of the instruction. Also in 2010, there were comments about logistical challenges in the course. For example, in 2010, a student stated, "The syllabus was really confusing …" and stated that instructors should "enforce time limits on student presentations." Other student comments: "As close to being there without getting

on a plane"; "This is one of the best courses I have ever taken"; and "[The adventurer] provided a ton of online resources and kept an audio blog EVERYDAY after he left [student's emphasis]." In 2011, the comments focused on the adventurer's satellite phone calls and audio blogs, but lacked the more positive tone offered in 2010. For example, in 2010, a student stated, "I loved the inclusion of guest speakers," whereas in 2011 a student stated, "[The adventurer] called in every week," in response to the prompt "What most helped your learning?" In general, comments were more detailed in 2010 than in 2011.

DISCUSSION

The results on course rigor indicate that even though the courses employed AL and SAE to varying degrees as alternative methods of instruction, students did not find the courses any more difficult than an average course at the U of M. This is of particular importance given the added technical competencies required of students when working in a learning environment that relies heavily on digital technologies. For example, because essential course materials were posted online, students not only had to learn the content presented in the course, but they also had to learn how to utilize the CMS and accompanying technology. In 2011, the Ning CMS involved an even greater learning curve because of the expectation that students would use the online discussion boards. In this instance, students faced not only potential technical barriers, but also social ones: interacting with academic content and other students in an online context requires a skillset different from face-to-face interactions (McGill & Klobas, 2009). So while students found the CMSs to

be of varying levels of effectiveness, they did not find that they affected the overall rigorousness of the course.

The courses were perceived as highly unique, which could be expected; however, what was somewhat unsure was if over time the courses would be perceived as less unique as international online learning became more common on campus. Further inspection of the open-ended comments revealed that the AL instructional technique offered an authentic and engaging method. Student statements noted above support this point, and it is also well documented in the AL literature (Doering, 2005; Doering 2006; Doering et al., 2008). Interestingly, as the courses became more focused on student-guided discussions and inquiry and less on guest speakers, students desired even more interaction with the adventurer's travel-based context. This exhibits the power of further integrating AL and SAE learner-centered approaches to prompt students to engage in further systemic and systematic inquiry. During a student feedback session at the end of the 2011 course, students also discussed the desire to engage in more action-oriented learning during and after the course.

One of the broader impacts of the authentic nature of the learning experience is that students reported that their desire to travel abroad increased as a result of the course. As the University of Minnesota's College of Food, Agricultural and Natural Resource Sciences seeks to further develop students' intercultural capacity, courses of this nature could offer a gateway for students to explore international experiences in engaging, real-

life ways without the added cost of travel abroad. In the years since AGRO3480 was offered, the U of M has implemented other courses that utilize distance technologies to engage learners in international experiences. One major question remaining is whether quantitative assessments will show that such courses effect shifts in intercultural competencies.

The positive response to the WordPress/WebVista CMS can be attributed to a few factors. For one, WebVista was already familiar to U of M students because it was used extensively in other classes. This may mean that students encountered few technical barriers. Additionally, the rise in perceived effectiveness of the WordPress/WebVista CMS in 2010 could be attributed to better delivery by the instructors because they had used the same CMS for the 2009 iteration of the course. When compared to Ning, it appears that students preferred the WordPress/WebVista, though it is unlikely that the results are statistically significant, and without a full representation of the class (an average of only 35% responded to the survey at the end of the course in 2011 because the survey was given digitally and many students did not return it), the sample is not necessarily indicative of the whole class population. The 2011 introduction of Ning was the first time instructors had used this CMS, and it is possible they were unable to use it to full advantage. Similarly, because it was the students' first time with this CMS, they may have experienced some technical barriers. Also in 2011, when Ning was first used, general community members and K-12 students were using the site in addition to U of M students. These added layers of complexity may have led to an overcomplicated design of

the CMS, leading to user frustration. That said, it appears that students did not visit the CMS any less in 2011 than in 2009 and 2010, despite the change in CMS.

One of the thrills and challenges of delivering a high-quality Adventure Learning experience is the heavy reliance on educational technology. As the course evolved, the content management systems changed from WordPress and WebVista to Ning. These are the most notable of the changes outlined in Table 1.2. The move from WordPress to Ning enabled the team to offer students added interactive functionality through discussion forums, and the chance to personalize their online environment through the My Page feature, which gave every student a Facebook-style wall that enabled them to project their identity more fully in a digital environment. Building social presence has been shown to enhance the learning experience, though only if the technology is effectively used (Annand, 2011).

Interestingly, students perceived the adventurer differently in 2010 compared to 2011. They perceived the adventurer more positively in the earlier course. This could be due to differences in course design, adventurer online social presence, degree of in-class presence, or changes in student demographics. In 2010, the adventurer was in the St. Paul classroom for the first half of the course because his leg of the Tour d'Afrique ride did not start until midway through the semester. This likely allowed students to gain a greater personal connection with him and likely resulted in a more personal connection to the narrative of an adventurer bicycling cross-continent. In 2011, the class experienced the

adventurer primarily through the CMS. This lack of face-to-face interaction could have resulted in the less-positive response to the adventurer, or it could reflect problems students said they had in utilizing the CMS. It is also possible that the adventurer was less focused in his communications due to the added responsibility of overseeing and teaching three U of M students who were accompanying him on the 2011 ride. Regardless, this result further indicates, consistent with findings in the literature, that it is of utmost importance for an adventurer to portray a strong online social presence (Annand, 2011). It is worth remembering here that a primary reason for shifting to the Ning CMS in 2011 was Ning's increased capacity to build social presence. Perhaps in regard to establishing a personal connection to the adventurer, this goal was unsuccessful, and the technology may not have been used effectively.

When employing AL and SAE strategies, logistics are everything. Not only did the adventurer need to perform a physically demanding feat, but he also had to capture and process multimedia, and deliver coherent, high-quality instructional material to students via (sometimes unreliable) online infrastructure (Miller et al., 2008). Students' open-ended responses indicated that they sensed some logistical challenges in the delivery of the course in 2010. This would reflect instructors' perceptions of the 2010 course as well. The course was being co-taught for the first time, which presented some logistical challenges. It appears that these logistical challenges were largely smoothed out by the 2011 course based on student responses, though new challenges were introduced with a different CMS.

Through a series of reflective discussions between the instructors and teaching assistants involved in AGRO3480, a few themes emerged about integrating SAE and AL. First, they stated that AL and SAE are profoundly compatible and complementary theories. Where AL fell short in describing food systems education, SAE could fill in the gaps, and vice versa. Because of their complementary theories, few theoretical tensions exist. However, main issues arose through practical implementation. One of the challenges in offering an undergraduate course of this nature was providing students with enough background knowledge to be able to fully engage. Ideally, through teamwork and group discussions, students would have been able to teach one another from their unique disciplinary perspectives, which did happen to a greater degree in 2011. But not all students had an adequate understanding of the relevant content areas to be able to make the kind of strong statements and connections that enhance learning. In these instances, instructors attempted to provide essential information largely through in-class discussion, although some questions were never fully resolved. The instructors felt that this issue should be more fully addressed in combining the theories: How do we prepare undergraduate students for complex, integrated analysis across multiple disciplines? This could involve recruiting students more heavily from disciplines that would provide a balance of disciplinary understanding in groups (Table 1.S5). Other ideas involve creating an online repository of core content modules that students could refer to if they lacked specific areas of understanding. Another idea was to open the course only to graduate students because they would potentially have a fuller background in the

disciplines needed for systemic study. While this revelation is not new within multidisciplinary courses, it is an essential issue that remains to be addressed.

CONCLUSION

In the novel course offering AGRO3480, in which students followed an adventurer as he bicycled for days on end, they were exposed firsthand to the tremendous agronomic diversity across two continents. In Africa they learned about the importance of the Nile River in providing irrigation for sugar cane in Egypt and cotton fields in Sudan; exotic and indigenous crops like teff and ensete in Ethiopia; flowers grown in greenhouses for export from Kenya, multicropping on small landholdings of subsistence farmers in Tanzania, rice production in Malawi; agroforestry in Zambia; cattle herds and ranches in Botswana and Namibia; and rooibos tea production in South Africa (Fig. 1.8). In South America, the students were exposed to the transformation of the Pampas in Argentina, the Mediterranean and desert climates in Chile, the Altiplano cropping systems in Bolivia, and the ancient terraced agricultures of Peru. The adventurer shared details of the more than 27 African and 13 South American ecosystems he encountered (http://worldwildlife.org/science/wildfinder/) and articulated how human beings have transformed those ecosystems into agroecosystems through their quest for food, fiber, and shelter.

Surveys show that students gained an appreciation for transport of food and agricultural products, and the limitations that a lack of infrastructure can place on productivity. They

experienced in a virtual environment stories of the daily need for food, water, and fuel for cooking. They learned how people access food. They saw the contrast between organic vegetable production in Chile intended primarily for American consumption, and the extreme poverty in Bolivia. They were curious to learn that virtually all the food consumed in Africa by the bicyclers was grown in Africa, and most was fresh and minimally packaged. The sights and experiences they encountered via the adventurer's narrative, triggered questions and lively discussion on a wide range of topics. They were exposed to the intersection of South American politics with access to land and land use. In 2011, one activity asked students to consider Bolivia's land redistribution programs. Midway through the activity, the comparison between the United States' land history and Bolivia's was made. After, students reflected on the tension caused in their mental frameworks because of the similarity of the initial situation in both countries where wealthy individuals purchased or stole land from indigenous peoples.

Systems Action Education and Adventure Learning fit well together at the process level and can effectively increase student desire to travel abroad and explore course content they wouldn't otherwise because of the uniqueness of the course content and delivery method. By merging the two methodologies, the classroom experience was more alive, and seemed to elicit a greater reaction from students than a lecturer or guest speaker. They share a common theoretical background, and complement weaknesses in the reciprocal method. More work is needed to weave both approaches together into a cohesive theoretical framework that can be implemented in food systems education.

Adventure learning projects present many challenges that need to be overcome ranging from technological and logistical to physical. The results indicated that while transitions were made in 2011 to increase online social presence, the technology or the implementation or both were flawed. While these challenges were present, none were too great to overcome. Most importantly the learning experience encouraged students to learn and explore the world beyond themselves.

Table 1.1. **Comparison of Systems Action Education and Adventure Learning**

	Systems Action Education	**Adventure Learning**
Student Levels	Undergraduate – Ph.D.	K – Masters
Intellectual Lineage	Dewey (1897) Kolb (1984) Hahn (Carver, 1997) Freire (1973) Bawden (1991)	Dewey (1897) Kolb (1984) Kirschner et al. (2004)
Medium of Instruction	In-classroom, Online, or Hybrid (Francis, 2012)	Hybrid or Online (Veletsianos, 2010)
Ed. Philosophy	Constructivism Experiential Learning Social Learning Trans-disciplinary	Constructivism Experiential Learning Inquiry-based Learning Social Learning Interdisciplinary
Topic of Study	Food systems	Proposed for any topic but principally used for science education
Online Content Type	Static case studies	Dynamic interactions

Table 1.2. **Agroecology Adventure Learning Project Evolution**

	2009	2010	2011
Geography Explored	Northern Africa	Southern Africa	South America
Theory to Practice	Adventure Learning	Adventure Learning	Adventure Learning and Systems Action Education
Key Learning Activities	In-class guest lectures, crop reports, cultural experience, midterm exam, final exam	In-class guest lectures, crop reports, cultural experience, midterm exam, final exam	In-class guest lectures, crop reports, cultural experience, student-led discussions, midterm exam, final exam
Adventure Communication	Daily audio blogs, weekly images with captions, weekly live conversation with U-Grad students in class	Daily audio blogs, weekly images with captions, weekly live conversations with U-Grad students in class	Daily audio blogs, weekly images with captions, weekly videos, weekly written blog, weekly live conversations with U-Grad students in class
Content Management System	WebVista WordPress (WP)	WebVista WP	Ning
Image Storage/Delivery	WP	WP	Ning
Video Storage/Delivery	WP	WP	Vimeo
Other Multimedia	Google Maps	Google Maps	Google Maps
Online Discussion System	-	-	Ning
Online Grading System	WebVista	WebVista	Moodle
Communication Technologies	Satellite phone, IBM laptop, email at Internet cafés	Satellite phone, IBM laptop, email at Internet cafés	Satellite phone, Mac laptop, email at Internet cafés
# of People Involved	2	2	3

in Course Delivery			
Adventurer Time in Classroom	Half a semester	Half a semester	A few class periods at end and beginning of semester
Primary Form of Instruction	Face to face; twice per week for 75 minutes with teaching assistant Margaret Wagner	Face to face; once per week with Mary Brakke	Face to face; once per week with Mary Brakke and teaching assistant Bryan Runck

Figure 1.1. Map illustrates routes of adventurer's bicycle trips across Northern Africa (2009), Southern Africa (2010), and South America (2011). Map created using ArcGIS 10.2 (ESRI 2013).

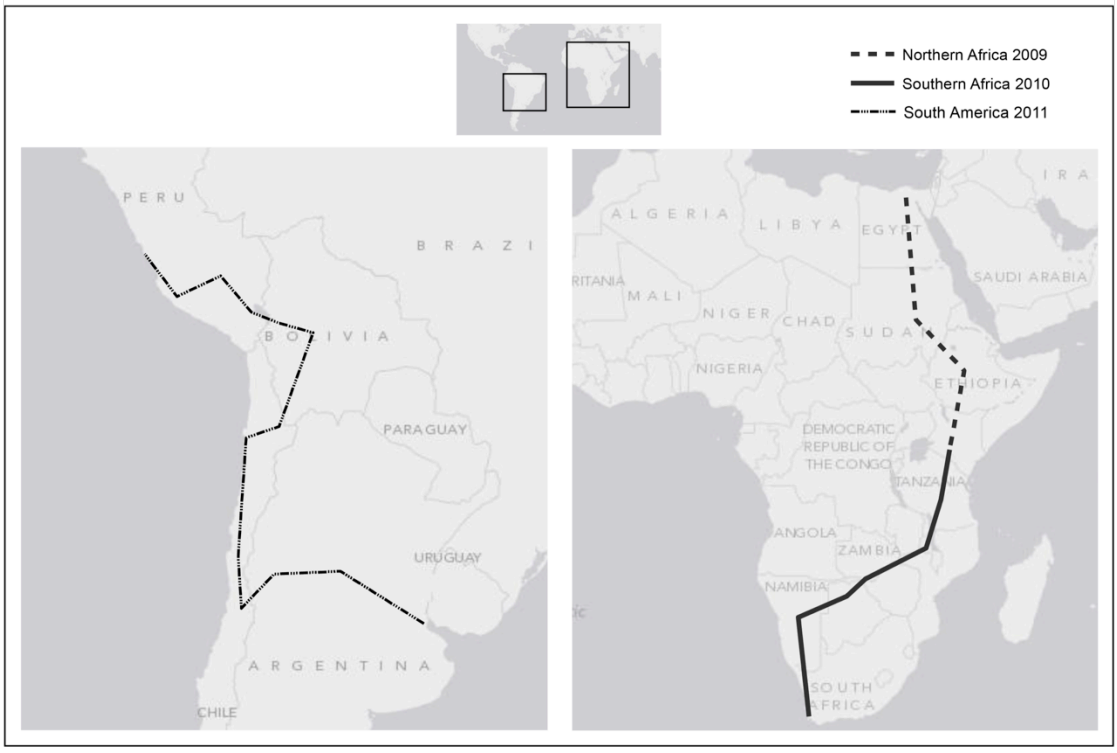


Figure 1.2. During each iteration of the course, changes were made to the technology. A) 2009, B) 2010, C) 2011.

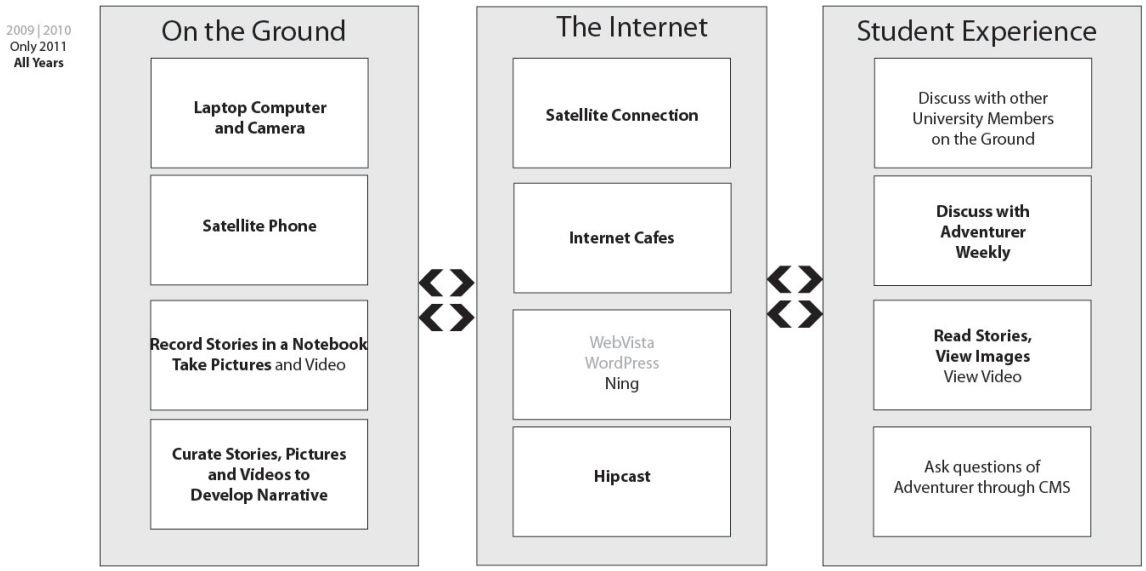


Figure 1.3. Student perceptions (n = 63) of course rigor on a 1-10 scale compared to U of M courses of the same level and credit revealed no statistically significant difference.

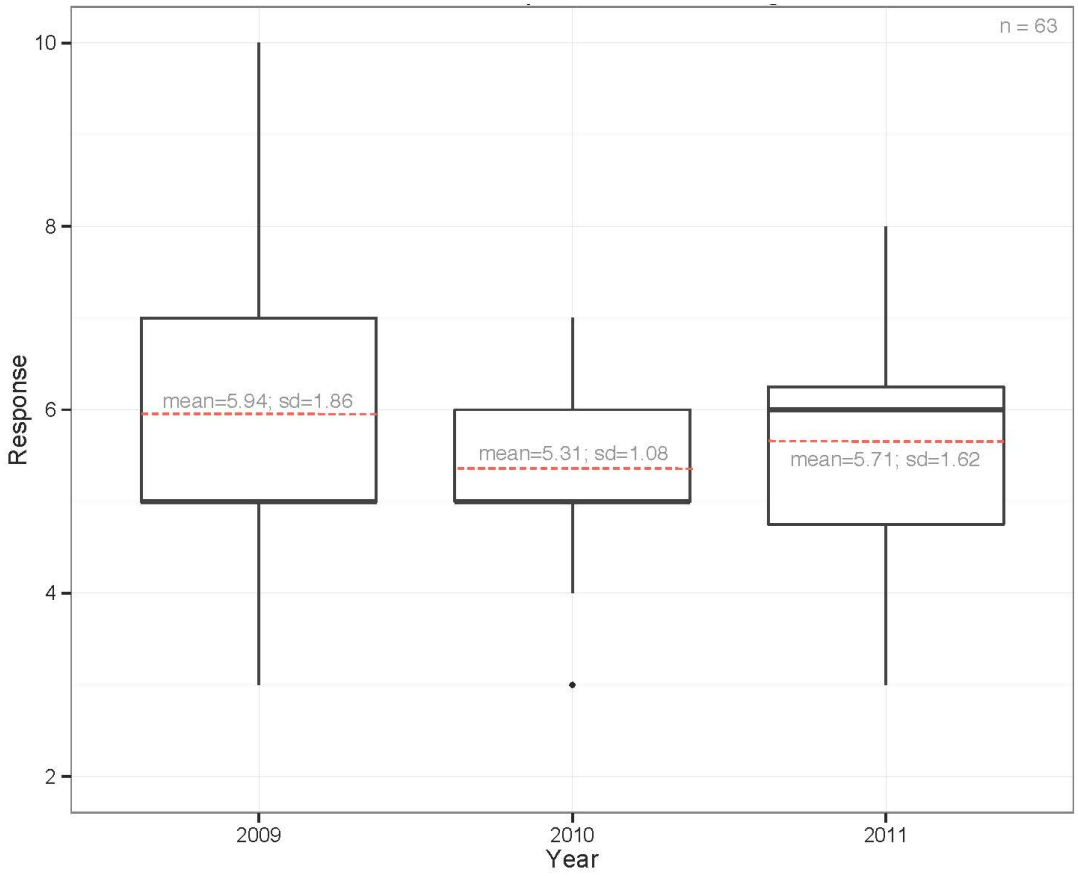


Figure 1.4. Student perceptions (n = 63) of the uniqueness of the course on a 1-10 scale.

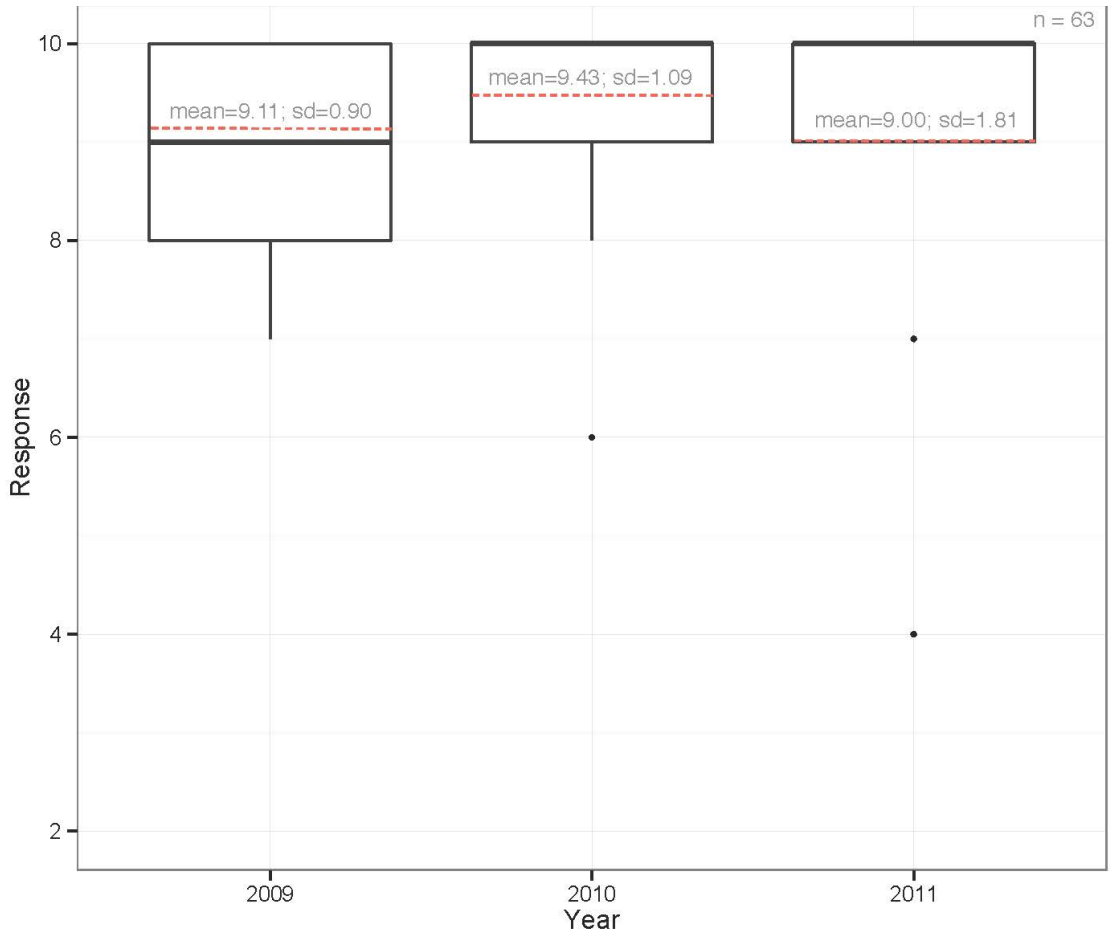


Figure 1.5. Students' (n = 63) perceptions of the effectiveness of course CMSs by year, rated on a 1-10 scale. Combined 2009 and 2010 data (n = 52) compared to 2011 (n = 11) data potentially revealed that students perceived the WordPress/WebVista CMS as more effective than the Ning (p = 0.03). Because all 2011 course enrollees did not respond to the survey, these results must be interpreted with caution.

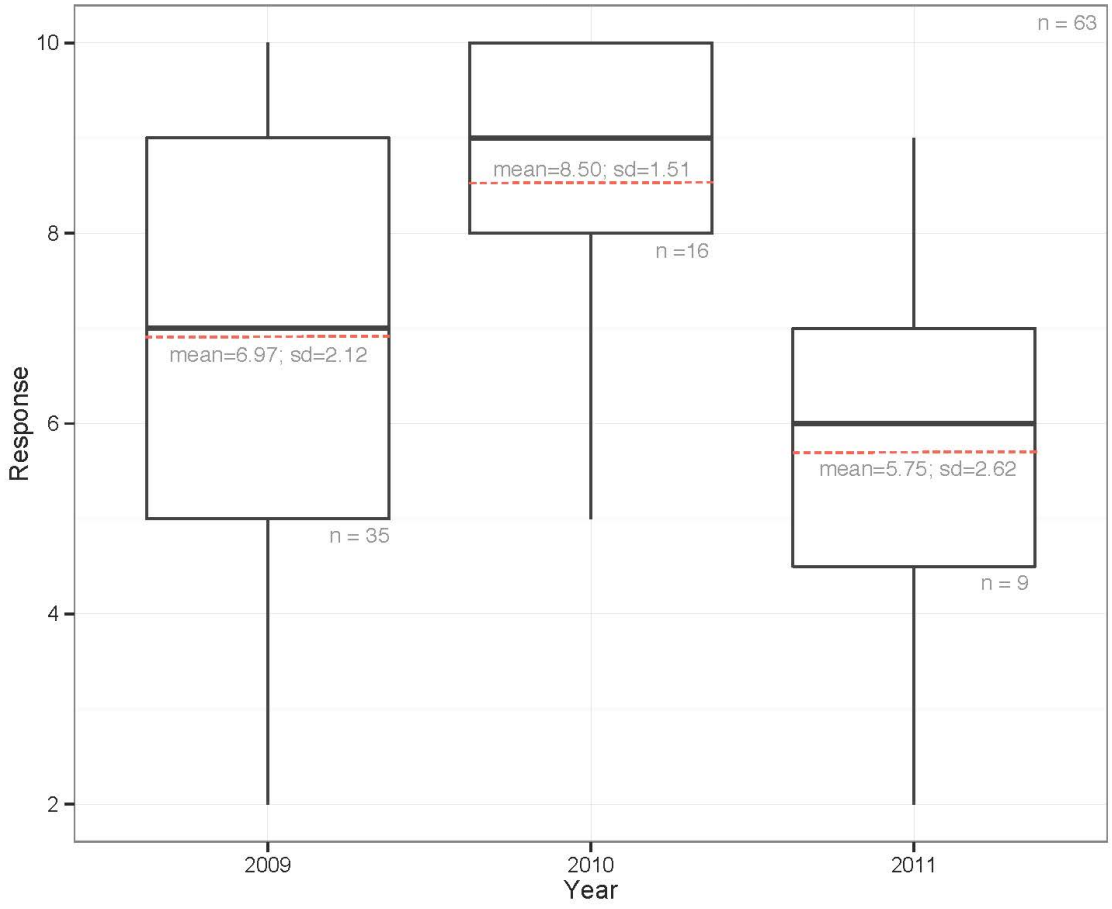


Figure 1.6. Students perceived the course as increasing their desire to travel abroad ($p < 0.01$), with no difference between years the course was offered.

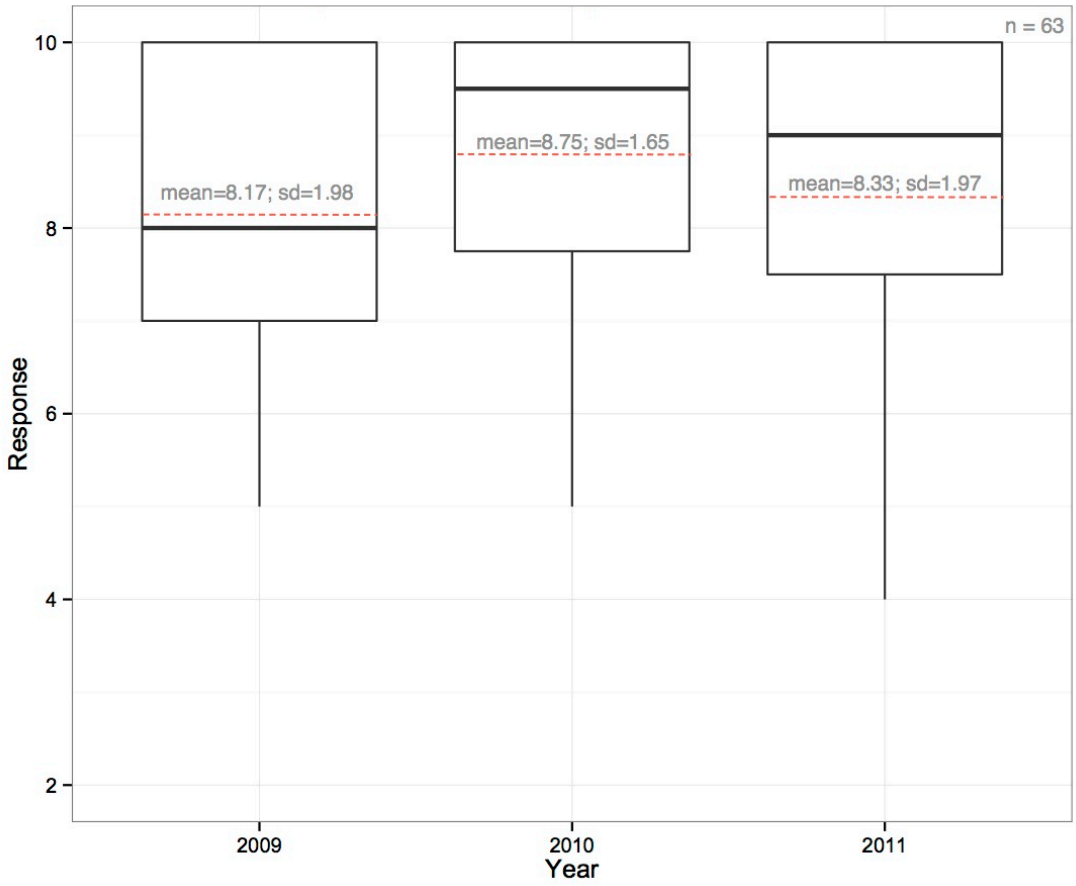
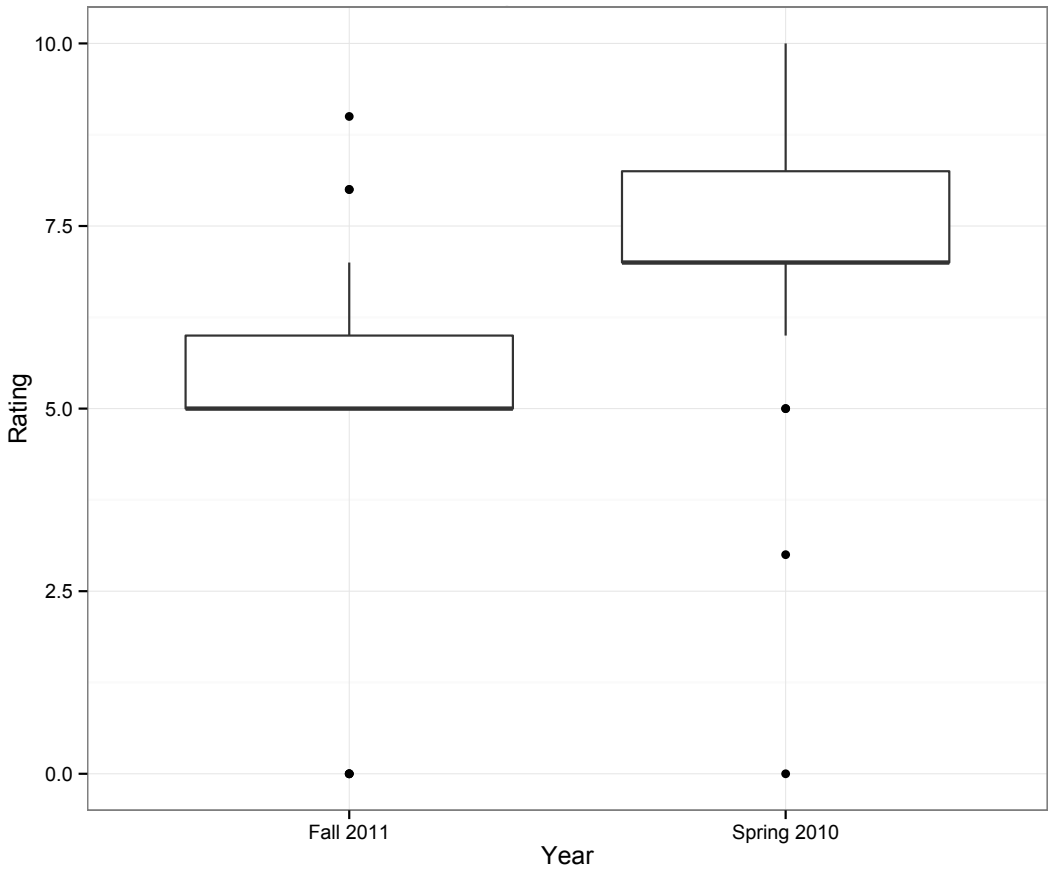


Figure 1.7. Coded student comments revealed that students perceived the adventurer more positively in 2010 than in 2011 ($p < 0.01$) (Thick black bar represents median).



Chapter 1 Supplemental Materials

Agroecology Education by Bicycle on Two Continents: Student Perceptions and Instructor Reflections

Supplemental Table 1.1. Relationship between bicycle expeditions and semesters at University of Minnesota

Expedition / Course	**Expedition start – end**	**University of MN semester start - end**	**Enrollment**
Tour d'Afrique 2009 *(Paul returned to class March 23 after an injury.)*	Jan. 10 – May 9	Jan. 20 – May 16	35
Tour d'Afrique 2010 *(Paul started in Nairobi on March 14.)*	Jan. 17 – May 15	Jan. 19 – May 15	20
Vuelta Sudam. 2011	Sept. 24 – Dec. 13	Sept. 7 – Dec. 23	24

Supplemental Table 1.2. Timeline and coutnries visited for 2009 and 2010 Tour d'Afrique rides

Country	***City***	*2009 dates*	*2010 dates*	*Section distance (km)*
1. Egypt	Cairo	10-Jan-2009	-	-
2. Sudan	Khartoum	20-Jan-2009	-	1,996
3. Ethiopia	Addis Ababa	15-Feb-2009	-	1,572
4. Kenya	Nairobi	14-Mar-2009	14-Mar-2010	1,610
5. Tanzania	Iringa	18-Mar-2009	26-Mar-2010	982
6. Malawi	Lilongwe	-	6-Apr-2010	1012
7. Zambia	Livingstone	-	16-Apr-2010	1,264
8. Botswana	Maun	-	22-Apr-2010	-
9. Namibia	Windhoek	-	29-Apr-2010	1,576
10. South Africa	Cape Town	-	15-May-2010	1650
			Total:	11,900

Supplemental Table 1.3. Timeline and countries visited for 2011 South America ride

Country	City	Dates (2014)	Additive Distance (km)
1. Argentina	Buenos Aires	Sept. 24	0
1. Argentina	Cordoba	Oct. 2	870
1. Argentina	San Juan	Oct. 8	1392
2. Chile	Santiago	Oct. 15	1812
2. Chile	Coquimbo	Oct. 22	2347
2. Chile	Antofagasta	Nov. 1	3288
2. Chile	San Pedro	Nov. 5	3670
3. Bolivia	Graci Mendoza	Nov. 12	4155
3. Bolivia	La Paz[†]	Nov. 19	(~500)
4. Peru	Puno	Nov. 23	4442
4. Peru	Cusco	Nov. 28	4841
4. Peru	Nasca	Dec. 7	5503
4. Peru	Lima	Dec. 13	5991

Supplemental Table 1.4. Topics presented by guest speakers for "Food and Agriculture from Cairo to Cape Town at 10 mph" and "*Food and Agriculture from Buenos Aires to Lima at 10 mph"* courses.

African Lecture Topics 2009-2010	**South America Lecture Topics 2011**
	Intercultural Conversations
A Human Perspective	Soils of South America
African Agroecosystems	Climate of South America
African History	Political Landscape in Argentina and Chile
Biofortification	Languages of Sustainability
Biological Nitrogen Fixation	Agriculture in Argentina
Biotechnology / CGIARs	An American-Latino Ride
Climates of Africa	Water Quality Issues
Cultural Perspectives	History of South American Food
Gates Foundation in Africa	Organic Production in Chile
GM Crops and Biodiversity Risk	Chile: Social Change and Development
Grain Storage Issues	Geography of the Bike Ride
Horticultural Crops	Reporting from Bolivia
Indigenous Knowledge of Soils	An Ethnobotanist View
Intercultural Differences	Diversity of Peru
IPFANS / Am's Univ. role in Africa	Cooperative Crop Research
Livestock in Africa	
Obesity and Poverty	
Social Work	
Soils of Africa	
Southern African History	
Tanzanian Whole Village Program	
UG99 Wheat Rust	

Supplemental Table 1.5. Total enrollments across all three years.

Major	Year		
	2009	2010	2011
Agri and Food Bus Mgmt	-	1	-
Agricultural Education B S	2	-	-
Agricultural Indust/Mktg B S	-	2	-
Animal Science B S	3	1	2
Applied Plant Science B S	5	2	-
Applied Plant Sciences M S	-	1	-
Applied Plant Sciences Ph D	1	-	-
Architecture B A	1	-	-
Bachelor of Design in Architec	1	-	-
Bachelor of Indiv Stdy B I S	-	-	1
Biology B S	-	1	1
Biology, Society, & Environ BA	-	1	-
Biosystems and Agr Engr	1	-	-
Ecology Evolution/Behavior B S	1	-	-
Economics B A	-	-	1
Env Sciences Policy & Mgmt B S	4	1	1
Environmental Horticulture B S	3	-	-
Food Science B S	1	-	-
Geography B A	-	2	-
German Studies B A	-	1	-
Global Studies B A	2	-	7
History B A	-	-	1
Horticulture B S	-	1	1
Inter-College Program B S	-	-	1
Journalism B A	-	1	-
Natural Resources Sci/Mgmt PhD	1	-	-
Non Degree	-	-	1
Nutrition B S	4	2	2
Political Science B A	1	-	3
Prog for Individzd Learning BA	-	1	-
Public Health Nutrition M P H	1	-	-
Sociology B A	-	1	-
Spanish Studies B A	-	-	1
Spanish/Portuguese Studies B A	-	-	1
Undeclared	2	1	-
Unknown	1	-	-
Total	35	20	24

Chapter 2: The Extended Classroom Framework: Integrated Education and Outreach

INTRODUCTION

Agroecology has a history of experiential, participatory learning that emphasizes systems thinking to address wicked problems (Bawden, 1991; Pretty, 1995; Jordan et al., 2008; Warner, 2008; Lieblein et al., 2012; Francis et al., 2011). Wicked problems differ from traditional problems in that they are ambiguous, poorly defined, context dependent, escape disciplinary solutions, and do not have answers that are right or wrong, only better or worse (Rittel and Webber, 1973; Batie, 2008). Because wicked problems cross multiple sectors and scales of coupled biophysical and social systems, they create management dilemmas (Foley et al., 2011; Polasky et al., 2010; Scheffer & Carpenter, 2003; Tilman et al., 2011). Additionally, the ever increasing complexity of coupled human-environmental systems, great concern exists surrounding "unknown unknowns" and system tipping points that could result in undesirable alternative steady-states or systemic collapse (Robertson et al., 2012; Dai et al., 2013). Many agroecologists have proposed solutions to guide society through wicked problems, and simultaneously acknowledge that we currently do not have the human capacity to fill positions required for these solutions (Dale et al., 2010; Francis et al., 2012; Jordan et al., 2013). As a result, agroecological education must continue to build student capacities in coupled human-environmental systems in order for solutions to be enacted and succeed.

Capacity building can be defined as "the process used in education to improve students' abilities to work effectively with challenges they will face in agriculture and food systems development and research programs" (Francis et al., 2012). The capacities future agroecologists need are as complex and diverse as the problems these students will seek to navigate. Building from experience, students' form capacities internally and externally. Capacity building from experience requires: 1) multiple types of internal dialogs (ie. reflective, abstractive, and visioning thought (Francis et al., 2012; Kolb, 1984)), 2) an open stance to difference (Taylor, 1994), 3) the ability to act observantly and responsibly across disciplines (Kuh, 2008), and 4) the ability to utilize multiple data types in ambiguous situations (Moncure & Francis, 2011; Francis et al., 2012). Developing these capacities plays an essential role in fostering "adaptive learners" who will be able to become the "adaptive managers" of coupled human-ecological systems. Reflectiveness in particular plays an essential role for further growth and life-long learning (Zimmerman, 2002). By combining reflectiveness with deep observation and the ability to abstract, adaptive learners can be visionaries of a more sustainable agriculture (Francis et al., 2012).

Deeply connected to reflectiveness, a student will need an open stance to difference, also known as an ethnorelativism, in order to work with people of diverse perspectives. Ethnorelativism is an advanced intercultural capacity. It is not simply working across geopolitical or racial boundaries, but rather reflects an individual's posture toward all that is culturally different; therefore, ethnorelativism is an essential skill for working between

urban and rural contexts, or between groups that adhere to different ideologies (Batie 2008). Experience that occurs with close observation, deep reflection, future visioning, and responsible action – outlined within Systems Action Education (SAE) (Francis et al. 2012) and Kolb's Learning Cycle (1984) – along with advanced intercultural capacities will allow future agroecologists to utilize understanding from multiple disciplines and their technical capacities. These technical capacities (particularly in digital and online collaborative environments) will utilize diverse data types – spatial, multi-scale, biophysical, and social – with the multiple groups of stakeholders in situations that will require unique solutions to context specific problems.

The task of developing these capacities within tomorrow's agroecologists is guided first and foremost by 'systemic' and 'systematic' thought and action (Lieblein et al., 2007; Lieblein & Francis 2010; Francis et al., 2012; Ison & Russel, 2000). Systemic study seeks to understand inter-related and reacting components of a system, whereas systematic study pauses and looks at an individual component through a specific 'way-of-knowing' to understand its inner-workings more deeply (Francis et al., 2012). Students then shift back-and-forth between these two types of study as they consider agroecosystems. Interestingly, not only is the process of shifting between these two types of study a skill in-and-of-itself, but it is a skill that builds other skills listed above. Such skills are impossible to teach through lecture and reading, but must be learned through active engagement and practice with authentic contexts. Authentic contexts result naturally in open-ended cases that provide the opportunity for ideas envisioned within the learning

process to impact reality, which further deepens and increases impact for students (Simmons 1992; Francis et al. 2009). However, open-ended cases within authentic contexts can also present financial, logistical, and legal problems (Francis et al., 2012).

Information Communication Technologies (ICT, e.g. Web 2.0 and mobile computing) could provide a means of delivering open-ended cases with even more impact and fewer challenges because of data-rich experiences of reality in online contexts. ICT has been developed within agroecology education (Francis et al., 2009; Lieblein et al., 2004). Within the general realm of sciences education, much work has been done surrounding Adventure Learning (AL) (Doering, 2006; Doering & Miller, 2009) through an online context, which has informed work done within agroecology (Francis et al., 2009). As argued in Porter et al. (in review), AL and SAE are synergistic educational frameworks with similar theoretical backgrounds. However, while they are synergistic, a more cohesive framework developed for an online context could better inform online design of open-ended case study education. Additional evidence for further developments within the frameworks came through reflective discussions with the adventurers and course instructors. It became apparent that these trips, while powerful for learning (Doering, 2010; Porter, et al. in review), were not necessarily sustainable at the personal or institutional level because of the toll such adventures can have on the adventurer's body and the financial costs associated with such trips. Similar concerns have been reported by other AL adventurers (Miller et al., 2008). Additionally, while the merger of SAE and AL were successful from a theoretical standpoint, the process of bicycling cross-country was

not ideal for exploring agricultural systems because it lacked the longer-term temporal perspective required to understand an agroecosystem. According to instructors from the 2011 deliver of the Porter et al. (in review) courses, students stated in group discussions that they desired more interaction with locals in situ so they could gain a first-hand perspective to compare with the readings and the adventurer's perspective. There were also concerns about how easily replicable an instructor bicycling cross-continentally was for other agroecology instructors.

To more fully address these areas of concern, further extensions were made to existing frameworks with the addition of perspectives from the science studies literature (Latour, 1999; Warner, 2007) to explicitly state the different spheres that a classroom could and should interact with in experiential agroecology education in order to maximize the authenticity and effectiveness of the systemic and systematic study (Francis et al., 2012). Additionally, Francis et al. (2012) in the recent review of SAE stated that an opportunity exists for open-ended cases in agroecology classrooms to be further expanded and enhanced through multimedia integration within online environments. Given recent advances in the power of online geographic information systems (e.g. Google Maps, ArcGIS Online) and online social networking systems (Ning, Elgg), the time was perfect for the envisioned advances. In response, the Extended Classroom Framework (ECF) was developed to explicitly integrate SAE, AL, and the Circulatory System of Science (CSS), which further builds on Lieblein et al. (2012) in describing the stakeholder groups necessary to engage in the agroecology education process (Latour, 1999; Warner, 2007).

The Extended Classroom Framework

The ECF was developed by combining CSS, AL and SAE (Fig. 2.1a). The goal in combining the frameworks was to offer a way to understand how an agroecology classroom moves about and interacts in society in general, but particularly in a digital environment. With the prevalence of online teaching and learning, online networks can be quite transparent (Brown & Adler 2008). Students can interact with the general public quite freely, and general public can interact with students. Given the permeability of the online context, it becomes logical to conceive of the student not only as someone learning agroecology at a university, but also as a developing practitioner playing the role of agroecologist disseminating agroecological information and creating new knowledge. The CSS provides a way to conceive of the scientist in society, and the process by which science is performed. By simply expanding our conception of 'student' to 'developing agroecologist' (per a life-long learning view of education), and expanding 'Content' or 'Links & Knots' within CSS to entail 'Issue and Place', it is possible to begin to frame how the action oriented classroom can interact in society.

The content that drives the students' inquiry process within a specific 'place' is 'issue' (i.e. wicked problems). In many respects, the issue will be a component of, or an entire, wicked problem. The 'place' is the geographic location of inquiry that has been instilled with human meaning. It is important to note that the concept of 'place' is different from 'space'. Whereas 'space' would imply a location without the narrative and emotional

connections necessary for deep care, concern and connection, a 'place' is location with layered levels of meaning on 'space' (Harrison & Dourish, 1996; Dourish, 2006). While this differentiation may seem like mere semantics to some, it is important because without a meaningful connection to a physical location – a connection that acknowledges the narrative that people have created in relationship to a geographic location – it is unlikely that a learner will be able to tease out the complexities of coupled human and environmental systems.

In the ECF, the next circulating conceptual level contains 'narrative' and 'collaboration' (Fig. 2.1). Both of these concepts build off of each other through group activities and class community building that result in stakeholders' and students' narratives merging. This merging occurs as the class community experiences collective experiences of complex situations as students inquire about issue and place. Issue, place, narrative, and collaboration form the nuclear core of the ECF.

The next energy state circulating around nucleus of the ECF informs the learning of the complex experiences through integrated social and biophysical data, data visualizations (e.g. interactive online GIS and graphs), which are housed in a flexible common curriculum that holds all of the components in motion around the nucleus. As the class community interacts with data and collaboratively asks questions, the process evolves (Evolving Process). Fundamentally, ECF places all members of the classroom as co-

learners, where students are as likely to dictate the process of questioning as much as the instructor.

The outermost ring of the ECF builds predominantly off of CSS and describes the necessary groups of stakeholders to include in the classroom community when exploring an issue and place (Fig. 2.1). The "General Public" consists of those who are not necessarily directly invested in agricultural production or the scientific exploration of agriculture, but have a stake within an issue and place. This group of people could range from those that live within a region that are impacted by the use of public ecological services such as water, or those who consume market or non-market goods coming from the agroecosystem. Students often fall into this category of general public in their day-to-day lives. "Agriculturalists" include those who are directly involved with landscape management (e.g. farmers, landowners) or who are directly working to impact landscape management (e.g. seed companies, fertilizer companies, nonprofits, governmental organizations). The 'scientific community' consists of scientists who are working on the basic and applied scientific problems (issues) associated with a place. The "Scientific Community" also includes course instructors. The "Natural World" is primarily included through direct experience of it as the place of inquiry. It's important to note that an individual can be a member of multiple spheres and can change spheres from moment to moment depending on the primary role an individual is playing. For example, if the issue were nitrate pollution and the place were southern Minnesota, an undergraduate student could be from a farm located in southern Minnesota that applies synthetic nitrogen to

their fields. Additionally, the same student could be performing undergraduate research considering the impacts of different nitrogen rates on corn yield and nitrate pollution across soil types. This would mean the student were a part of the agriculturalist sphere as well as the scientific community sphere while being a student in the course. Finally, the entire framework is housed in the directional flow of an authentic context that results in the creation of community artifacts (e.g. digital or analog objects) that serve as points of reflection both individually and collectively over time.

Systems Action Education robustly describes the general process of reflection within the agroecology classroom (Francis et al., 2012; Kolb, 1984). The steps of deep reflection, rich observation, future visioning, and responsible participation, while deeply individual, can also be a collective, social-learning process (Bandura, 1977; Francis et al., 2012; Rogers, 2010). By including a temporal component with the collective and individual perspectives, it is apparent that different individuals could be at different points in their individual learning cycles, and that subgroups of learners may have overlapping learning cycles as times progresses (Fig. 2.1b). This process of individual and collective reflection occurs within the constructs of the ECF and engages the class community in moving into deeper levels of 'systemic' and 'systematic' understanding.

The ECF seeks to codify the above listed disparate realms of thought to more fully guide instructors in the facilitation and integration of different aspects exploring wicked problems from multiple perspectives. Ideally, the framework would result in learning

experiences that would prepare learners to work across cultures, scales, and digital and analog contexts in order to build the capacities of agroecologists. In order to test the framework, a pilot hybrid course was developed in the fall semester of 2012 at the University of Minnesota (UMN) entitled Agroecosystems of the World.

Research Objectives

The goal in designing and implementing a pilot course with ECF was to test if the framework:

- Successfully instructed undergraduate students in agroecological inquiry across multiple global contexts through systematic and systemic inquiry
- Caused students to increase their ability to work within complex situations in relation to difference
- Developed students' environmental disposition as is related to responsible action, and
- Successfully integrated online geographic information systems and online social networks to engage students in exploring open-ended case studies systemically and systematically

MATERIALS AND METHODS

The fall semester of 2012, a 3-credit course Agroecosystems of the World (AGRO 3305) (n = 8) was offered through the College of Food Agricultural and Natural Resource Sciences (CFANS) at the UMN. The course sought to teach students how to:

1) describe important biophysical and social/cultural dimensions of agroecosystems and their interdependence and use this understanding to guide inquiry into agroecosystems,

2) access a wide variety of information sources and understand ways they can be used,

3) understand and use different inquiry approaches to study and characterize agroecosystems,

4) appreciate the significance of different perspectives, especially disciplinary, scale and cultural perspectives, in studying agroecosystems, and

5) recognize and appreciate their own cultural perspectives in relation food production and the environment and communicate and work effectively across cultural differences.

These objectives were chosen with the goal of creating a course that could fulfill the requirements of a new major on food systems at the UMN. After determining the learning objectives, the teaching team selected the places of inquiry for the course. Our criteria for selecting the places of inquiry were that 1) the places would build on existing relationships within CFANS at the UMN, 2) the places showed opportunity for growth beyond initial contact, and 3) the places that collectively represented a diversity of agroecoregions globally to provide students with interesting points of comparison and contrast.

For the first iteration of the course, the teaching team's goal was to establish one strong connection with a principal collaborator at each location with the future vision of expanding the number of people involved locally within each agroecosystem of inquiry so that a fuller exchange of agroecological thought could occur. This vision acknowledges the teaching team's place in the progression of intercultural education laid out by Burford et al. (2013). The practical aspects of the process of identifying places and collaborators involved talking with the Office of International Programs within CFANS as well as working with other administrators and faculty members within the college that had connections abroad. Because of the extensive connections with CFANS to varied international locations, we were typically only one to three social network connections removed from the person who eventually became our principal collaborator in each location. In order to be considered an acceptable principal collaborator, the individual had to be enthusiastic about engaging, have strong a strong base of knowledge related to an aspect of agroecological inquiry, and had to be actively engaged in agroecosystem management or research. We valued practical experience as much as formal education, and wanted to select a diverse group of people to engage with the classroom community. The final locations and spheres of our collaborators were Watonwan County, Minnesota, United States of America (Agirculturalists – Farmer); Guacimo, Costa Rica (General Public – Agronomic English Instructor at Earth University); Meknes, Morocco (Scientific Community – Soil Scientist); and Sauraha, Nepal (Scientific Community – Agriculturalists). Students represented the 'general public', and the 'natural world' was

represented through the online geographic information systems (GIS), the academic literature, and the narratives of class community.

After formalizing agreements, UMN instructors and the primary collaborators of each location jointly identified the issues and designed learning activities for the course. The design process varied for each location, but resulted in a set of exploratory labs that utilized media-rich online geographic information systems to guide students through different aspects of the agroecoregions (Fig. 2.2a & 2.2b). The only major variation in the laboratory exercises was for Costa Rica where there was a companion class at Earth University learning agronomic English that was associated with our principal collaborator at that location. In that instance, we co-designed a set of collaborative learning activities that required students from each university to interact through exchanging multimedia through the course content management systems (CMS), which in this case was a Ning social network. The primary learning objective for the Earth University students was to learn spoken and written agronomic English, which was complementary to the UMN students' objectives. The online laboratories were developed to provide a baseline understanding for students in the biophysical and social aspects of the agroecoregions as well as allow students opportunities to practice 'systemic' and 'systematic' inquiry using agroecosystem analysis theory (Conway 1985; Gliessman 2004; Power 2010; Visser 2000).

The course was delivered as a hybrid-course with half of the learning time spent online in the course CMS, and the other half occurring face-to-face (F2F) in class each week. For the CMS, we selected a Ning social networking environment because of the generally easy usability, dynamic integration of multimedia, and its design focus on online communities (Fig. 2.10c). All of these aspects were believed essential to enhance the ease of collaboration and the creation of a community narrative through authentic experiences resulting in artifacts. The online GIS were integrated with the CMS through either direct incorporation or external links. Each week, a weekly to-do list was posted with course tasks outlined clearly for students including all of the needed resources and links to relevant online places of interaction such as the discussion boards (Fig. 2.10d).

The 15-week semester course was broken into five predominant sections: three weeks to introduce students to the concept of agroecosystem analysis and practice it within a familiar context (Minnesota), six weeks to explore each agroecosystem and further refine their ability to inquire systemically and systematically through the online GIS and interactions with the collaborators on the CMS and via Skype conference calls, five weeks for students to guide the class community through an additional aspect of an issue within one of the four already studied places, and a final week for group reflection and synthesis. Each section was designed utilizing the nucleus of ECF: issue, place, narrative and collaboration. Class discussions focused on either systemic or systematic questions guided by all members of the class community at different points during the semester. The online GIS and media-enhanced CMS allowed students to explore and manipulate

data at multiple scales (field to global) and across biophysical and social contexts. A common curriculum was created utilizing the weekly to-do lists that oriented the community through self-guided explorations of the data. Each week, the process evolved as students posed questions in discussion. The climax of the course evolution occurred when students took charge of focusing the class on a specific issue and place. During this time, students provided all supplementary data.

Throughout the semester, students were asked to reflect individually and collectively. Individually, students wrote four reflective journals during the semester, and were prompted to reflect broadly on their learning in the course as well as specifically on their intercultural development, environmental disposition, and experiences of the online learning environment. Collectively, students reflected during F2F discussion and through asynchronous discussion forums. In addition to the reflective journals, students were given the intercultural development inventory (IDI) at the beginning and end of the course with an individualized F2F feedback session and a group feedback session with trained IDI qualified administrators. Students also took the New Ecological Paradigm (NEP) scale at the beginning and end of the course. Students did not receive any feedback on their score for that survey.

The IDI is a 50-item instrument in its third version developed by Hammer et al. (2003) to assess “orientations toward cultural difference” as described by the developmental model of intercultural sensitivity (DMIS) (Bennet 1986, 1993). The underlying assumption of

the DMIS is that "as one's experience of cultural difference becomes more complex and sophisticated, one's potential competence in intercultural relations increases" (Hammer et al. 2003). This assumption assumes that knowledge of the world is constructed as one experiences events (Kelly 1963), and that the more tools an individual has to utilize in perceiving the world, the more complex the construction of the world and thus, the more completely one can construct and understand culture. The DMIS also assumes that construing cultural difference on an on-going basis can become a part of one's worldview. The DMIS consists of six categorical worldviews that describe how someone is oriented toward cultural difference. Three of the orientations are "ethnocentric" or "monocultural" in nature, and three are "ethnorelative" or "multicultural" in nature. For a full list of DMIS orientations measured by the IDI, and their definitions, see Table 2.1. The IDI has undergone extensive validation and reliability testing (Hammer et al. 2003; http://www.idiinventory.com) and can be used to assess group or individual intercultural development. In addition to measuring one's cultural orientation, the IDI also gives measures of cultural disengagement (CD) or how connected one feels to a primary cultural group on a scale of 0 to 5, with anything four or higher indicating that the individual is resolved and feels connected (Table 2.1). Because of the importance of agroecologists to inquire systemically and systematically across cultures, success in systemic and systematic inquiry requires students to perceive multiple nuances of cultural difference. The IDI directly measures this skill.

The NEP scale is a fifteen-question instrument with a little over thirty years of validation that measures one's disposition to the environment and indicates the probability of pro-environmental behavior (Dunlap et al. 2000; Dunlap 2008). The NEP scale represents a continuum that is split between the dominant social paradigm (DSP) and the NEP. The instrument consists of five different aspects of an ecological paradigm that measure on a Likert scale the continuum between these two worldviews. It then quantifies one's placement within the five hypothetical aspects of an ecological worldview: the reality of limits of growth, antianthropocentrism, the fragility of nature's balance, rejection of exceptionalism, and the possibility of an ecocrises. The NEP Scale directly relates to responsible action within the reflective process described in ECF by measuring students' disposition toward issues of broad societal concern.

UMN student reflective journal prompts were administered through the course CMS in the weekly to-do list; students used a word processer to respond and then emailed their responses to the course teaching assistant. The IDI and the NEP pre- and post-tests were taken via an online survey tool to UMN students outside of class. Response rates were 84.0% for the four reflective journals, 100% for the IDI pre- and post-tests, and 62.5% for the NEP pre-test and 37.5% for the post-test. Reflective journals were coded and thematically analyzed according to Richards (2009). Journal responses related to the online GIS and CMS were additionally coded numerically on a 10-point scale from 0 (highly negative) to 5 (neutral) to 10 (highly positive) according to Svensson (2001). Pearson's Chi-Squared and Paired sample t-test statistical tests were performed according

to Snedecor and Cochran (1989). Confidence intervals and standard errors were calculated according to the standards for within-subject calculation (Morey 2008). All data were analyzed using the R Statistical Environment (R Core Team 2013), managed using reshape2 (Wickham 2007), and visualized using ggplot2 (Wickham 2009).

RESULTS

A Paired t-test revealed no statistical difference on the group pre- and post-tests for the IDI (n = 7). At the individual level, a move of 7 points or greater has been found to be significant for the full-scale IDI items (Bennet et al. 2003; http://www.idiinventory.com). Confidence intervals were calculated according to Morey (2008) of ± 6.75, which is similar to the recommendations of true difference at the individual level by Bennet et al. (2003; http://www.idiinventory.com). At the individual level, 100% of students showed significant differences in the developed orientations (DO) measuring students' intercultural development, though one student showed this difference negatively (Fig. 2.4 and Fig. 2.5). Four out of seven students showed significant decreases in their orientation gap (OG) (Fig. 2.5), the difference between someone's perceived orientation (PO) and their DO, which illustrates someone's internal reflective capacity and awareness. Every student ended the course the same or less culturally disengaged to a primary cultural group, with 85.5% of students in the resolved category where they feel engaged with their primary cultural group, which compares with 57.1% at the beginning of the course (Fig. 2.15).

A Paired t-test of the group results on the NEP showed no significant difference pre-test ($n = 5$) and post-test ($n = 3$). Individually, because the sample sizes were small there were no significant differences; however, all individuals moved toward the NEP with one student of three showing a shift of 16 points from the DSP to the NEP on a Likert scale of 15-75.

Numerical coding of students' reflective journals related to the online GIS revealed that students perceived the GIS positively aided their learning. A Chi-Squared test revealed students perceived the online GIS to significantly aid in their learning compared to neutral ($p < 0.01$). Qualitative coding and thematic analysis revealed that students perceived the online GIS positively because of its ability to allow them to consider scale, multiple perspectives, fact check readings from collaborator discussions, and juxtapose the interactive data with information in course readings. Students also reported frustration because of technical difficulties related to slow loading times and "buggy" interfaces.

- … I especially liked the fact that the videos didn't last for too long (they were only 2 min long) so they kept my attention and they also consisted only the essential information we needed.
- As we focus on a sliding scale from global to local, the GIS systems have helped extraordinarily in learning the ecological functions, topography, etc., of the different areas that we are studying. This is a great visual aid in furthering my understanding of an area and being able to relate more with local issues.

- The GIS maps provided a good juxtaposition against the articles and the direct information from the collaborators and EARTH students. It was a good way to get a sense of the geography and natural features in each location.
- For a first time user the GIS systems are extremely frustrating, but after I get things figured out, the information I get from them is valuable.
- It worked well enough. Some of the interfaces were buggy. It might help if there were a lower threshold for software/apps.

Students perceived the Ning online social network mostly positively and as a beneficial way to organize their learning; however, students reported that the discussion forums could be difficult to follow because of the design. A Pearson's Chi-squared test of numerically coded responses showed no significant difference from neutral in their responses. Student reflective journals revealed that students mostly found the Ning CMS novel and useful, particularly when combined with other in-class activities like distance discussions via Skype or conference call with our primary collaborators. However, this sense was not unanimous with some students feeling "it didn't work well for [them]". A common response was that it took students time "to get used to".

- I think that all aspects of this course have helped contribute to my learning including the online Ning community, collaboration with professionals from these countries, and the GIS applications that were used.

- It didn't work well for me. Seemed to work better for other students. Granted, my participation with Ning was limited, but I felt there was a disconnect between the forum discussions and the class meetings.
- The Ning site works pretty well. There are a few elements that are tricky. For instance, it was sometimes challenging to follow the online discussion in the beginning. Also, most recently, when putting up the page for the group project, it was tricky trying to create a new page. Those are minor elements; overall the Ning site is a good component of the class.
- I think that Ning is a great tool for classroom instruction. Besides the fact that it is easy to use and understand it provides students with a different classroom experience. I will admit that it took a little while to get used to and feel comfortable with but now I am convinced it is a very effective tool. I think that the best aspect about it is the ability to continuously connect with classmates and other classes from around the world. Ning allowed us to communicate with the Earth students in a way that was extremely beneficial.

Additionally, the theme of confidence in culture emerged through time in the reflective journals. Students became more confident in their ability to describe culture and their intercultural development. In the first reflective journal:

- Every time I am confronted with this question, I am never sure quite how to respond.

- Broadly, I identify myself as a White Midwestern 21st Century Male that is more defined by my beliefs and dreams, than by a title. As a 7th generation American, I do not reflect my ethnicity, yet my culture is a smorgasbord of other collective ideals that have become mass marketed.

In later reflective journals:

- I realized that I have at many times exhibited elements of the minimization in that more often than not I have a tendency to focus on the common humanity of people.
- I've started at stage called denial. Sometimes I still feel like I am there and sometimes I feel like I improved. I am open to different cultures and I am very interested in others countries tradition but I still find myself surprised in some situations.
- I feel like being aware has helped me the most in making progress in this area [intercultural development]. However I do believe that have the real interactions with the collaborators was the most helpful for the progress. Especially being able to hear the different viewpoints and discus them afterwards.

Simultaneously, students reported being less judgmental of different methods of agroecosystem management through time. Students specifically stated that interactions with the principal collaborators and Earth University students through online discussions, qualitative GIS layers, and synchronous Skype and conference calls played a significant

role in their change in perspective. Students expressed that they wanted more exchange with Earth Students. Specifically, students stated that they wanted the exchange to be more two-way for agroecosystem multimedia transfer.

- The reason that I made these understandings was because at first I was confused by what was going on, and thinking that people of different cultures were doing things wrong with their agriculture practices, and thinking just a little thing would make things better. How I got over this was by listening to people, and watching videos of people and their living situations really helped me.
- At the beginning of the semester I was judging other cultures that were too different than mine and I wasn't aware of it. Today I still find myself not approving some acts of people from different cultures but at least I am aware of it and I try not to judge it.
- This has been very helpful in framing my thoughts about how to approach problems that people are very sensitive too, such as changing farming practices.
- I still think that that is important, but taking this survey a second time really made me incorporate thinking about the importance of recognizing and talking about difference and how it can be used to better solve problems. The interactions in the course with the collaborators, instructors, and other students have helped me grow in my thinking in that sense.

The individual and collective aspects of the reflective process are evident in the reflective journals. Students discussed how interacting with other contexts through online resources

and directly with the collaborators and Earth University students (rich observations) caused them to reflect on their current understanding of agriculture (deep reflection). In response, they discussed the potential that exists globally for new technologies and governance systems to increase the sustainability of agroecosystems holistically (future visioning). Finally, students discussed multiple places within their journals about their excitement to implement future visions in their local contexts to enhance agroecosystem sustainability (responsible participation), all of which are illustrated in the above examples.

DISCUSSION

The ECF showed promise in delivery education that 1) successfully instructed undergraduate students in agroecological inquiry across multiple global contexts through systematic and systemic inquiry; 2) caused students to increase their intercultural competencies; and 3) successfully integrated online GIS and online social networks to engage students in exploring open-ended case studies. However, the results for the ECF to develops students' environmental disposition were unclear and incomplete.

Student reflective journals consistently revealed that students increasingly exhibited and perceived in themselves the ability to consider agroecosystems as complex interconnected systems, and they did so from multiple cultural perspectives. The primary gateway to thinking in this manner was through interaction with our primary collaborators utilizing synchronous video and telephone conferencing technologies;

secondly, students perceived the online GIS having a significant role; and thirdly, students acknowledged the importance of online and in-class discussions in-spite of technical difficulties with both the GIS and the Ning. Interestingly, students perceived the online GIS more positively than the Ning when coded numerically. Assuming methodological soundness, Kirschner et al. (2004) provide the lens of 'affordances' to interpret this result through. 'Affordances' are "different opportunities provided by a learning environment … for action" in technological, social, and educational contexts (Kirschner et al. 2004). Technological affordances of an object are linked to its usability (Norman 1988). For human-computer interaction, this primarily comes down to whether or not the computer efficiently and effectively satisfies the user's goals. In the case of both digital tools, they operated at less-than-ideal. It could be, however, that the end goal of accessing novel data and questioning assertions within academic publications provided a more important end goal than discussing articles with fellow students – particularly in light of the potentially transferability of affordances from the Ning to other forms of social affordances that offer social interaction, such as F2F or video and telephone conferencing. The online GIS did not have a similar, replaceable technology. Under the final lens of educational affordances, we could imagine a similar logic applying: the self-guided knowledge that could be gained within the online GIS was more novel than the Ning, and therefore, despite difficulty, the potential outcomes were perceived as so valuable that they motivated students to work through the technological difficulties.

The IDI revealed that the affordances of the learning environment impacted the intercultural capacity significantly either negatively or positively. Based on the reflective journals, it appears that this increased ability to approach difference allowed students to more fully consider agroecosystems 'systemically' facilitated by the online multimedia and GIS. This result aligns with the view that "the crux … is the ability to construe (and thus experience) cultural difference in more complex ways" (Hammer et al. 2003).

CONCLUSION

The development of the ECF responded to the need for a fuller integration of SAE and AL and utilized CSS in the process. The pilot course showed promising preliminary results that the framework can successful design learning environments that build capacity in future agroecologists. This study looked at the multifaceted aspect of capacity building from multiple, mixed methods perspectives, and it seems to show a promise. The area where students revealed the most concern was in the ease of use of the technology. The problems with the technology seemingly occurred either as a result of a learning curve, poor design, slow internet speeds, or a mixture of all of the above. While these technological problems were unfortunate, they can be addressed in the future to minimize their occurrences and their impacts when they do occur. ECF's potential to build student capacity is encouraging, but these results are still very preliminary with a small sample size and should therefore be interpreted cautiously. Work needs to be done to more fully test the framework, and to do so with adequate controls. Additionally, the impact of the framework on environmental disposition is still unclear. Therefore, more research will

need to be conducted to know whether or not the framework would be worth implementing on larger scales, but these preliminary results indicate that ECF would be valuable to further explore.

Table 2.1: An overview of the developmental model of intercultural sensitivity (DMIS adapted from Bennet *et al.* 2003)

General Orientation	**Specific Orientation**	**Description**
'Ethnocentric' or 'Monocultural'	Denial	Orientation recognizes observable cultural difference (e.g. crop selection), but may overlook deeper cultural differences (e.g. implicit cultural values surrounding management) and may avoid or withdraw from cultures
	Polarization	A judgmental view of culture with an 'us' versus 'them' mentality that takes the form of reversal and defense.
	Reversal	A critical view of one's own cultural values and practices and uncritical view of other cultural values and practices
	Defense	A critical view of other cultural value and practices, but not of one's own
'Ethnorelative/ ethnocentric' or 'Mono/ multi-cultural'	Minimization	Orientation that highlights the commonality of human experience, but may mask deeper recognition and appreciation of cultural differences
'Ethnorelative' or 'Multicultural'	Acceptance	A view that recognizes and appreciates cultural differences in one's own and other's cultures
	Adaptation	An orientation that is able to shift perspectives and behavior based on cultural situation in appropriate and authentic ways
Separate Indicator from the DMIS, but measured by the IDI	Cultural Disengagement	A sense of disconnection from a primary cultural group

Figure 2.1. a) The *Extended Classroom Framework* (ECF) describes the collaborative, social process of learning in an online international context. b) A major aspect of the ECF is the intersection of group and individual reflective processes over time. Each small circle represents one member, whereas the larger circle represents the collective process.

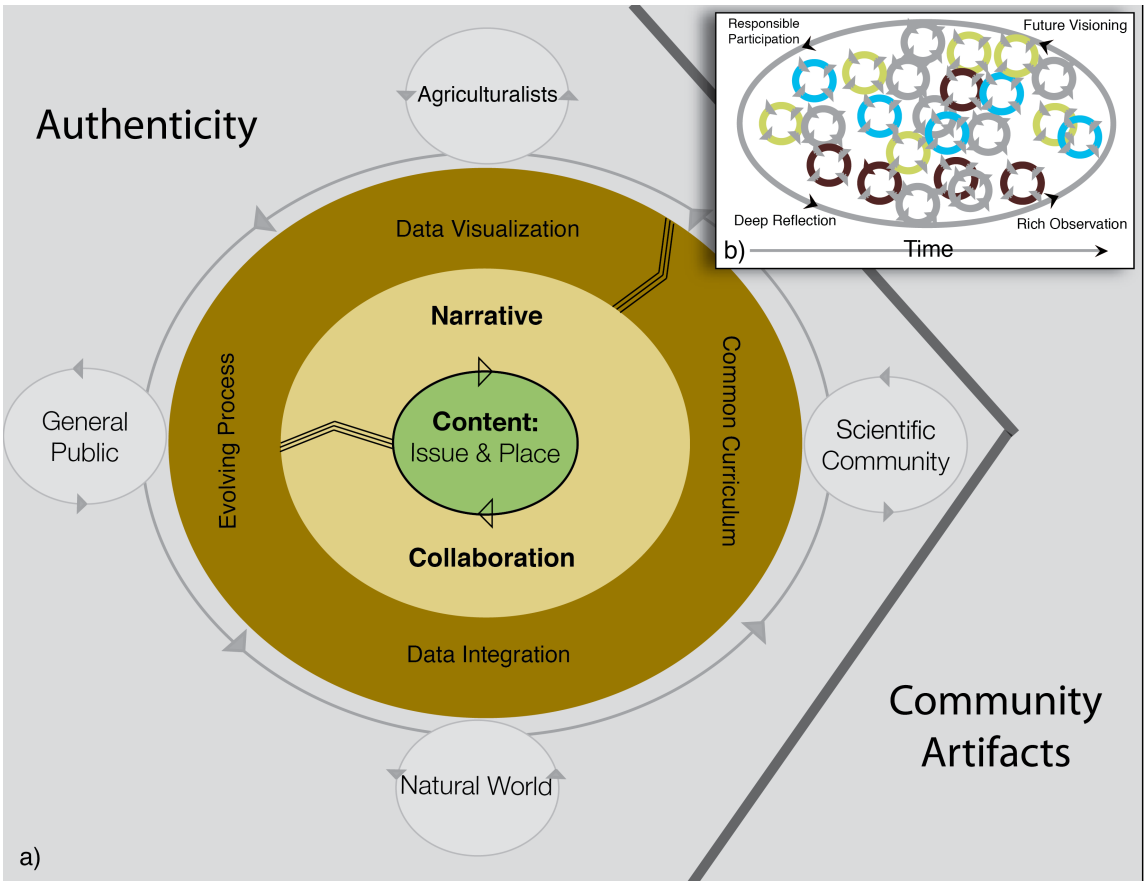


Figure 2.2. Online geographic information systems (GIS) were designed utilizing a variety of free tools ranging from a) ArcGIS Online and b) the Google Maps Javascript API with embedded YouTube Videos. The Ning content management system not only provided a c) media-enriched place for the learning community to collaborate and build narrative connections, but it also provided a place to (d) clearly organize the course each week.

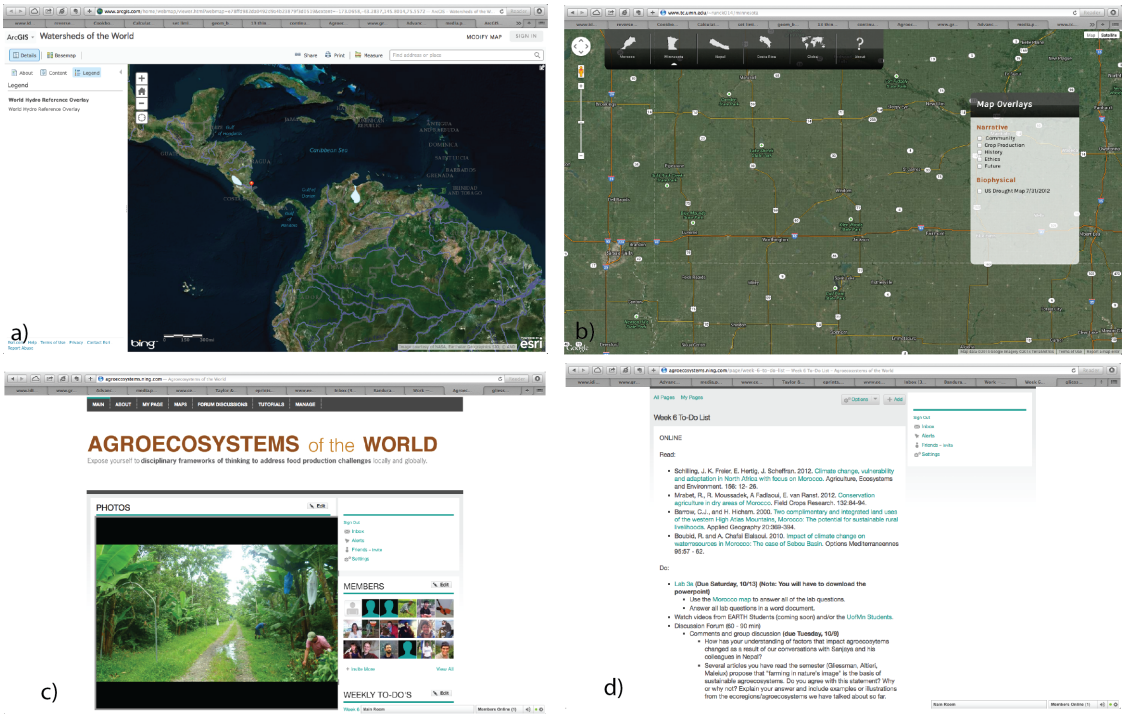


Figure 2.3. Group developed orientation (n = 7) results for the IDI.

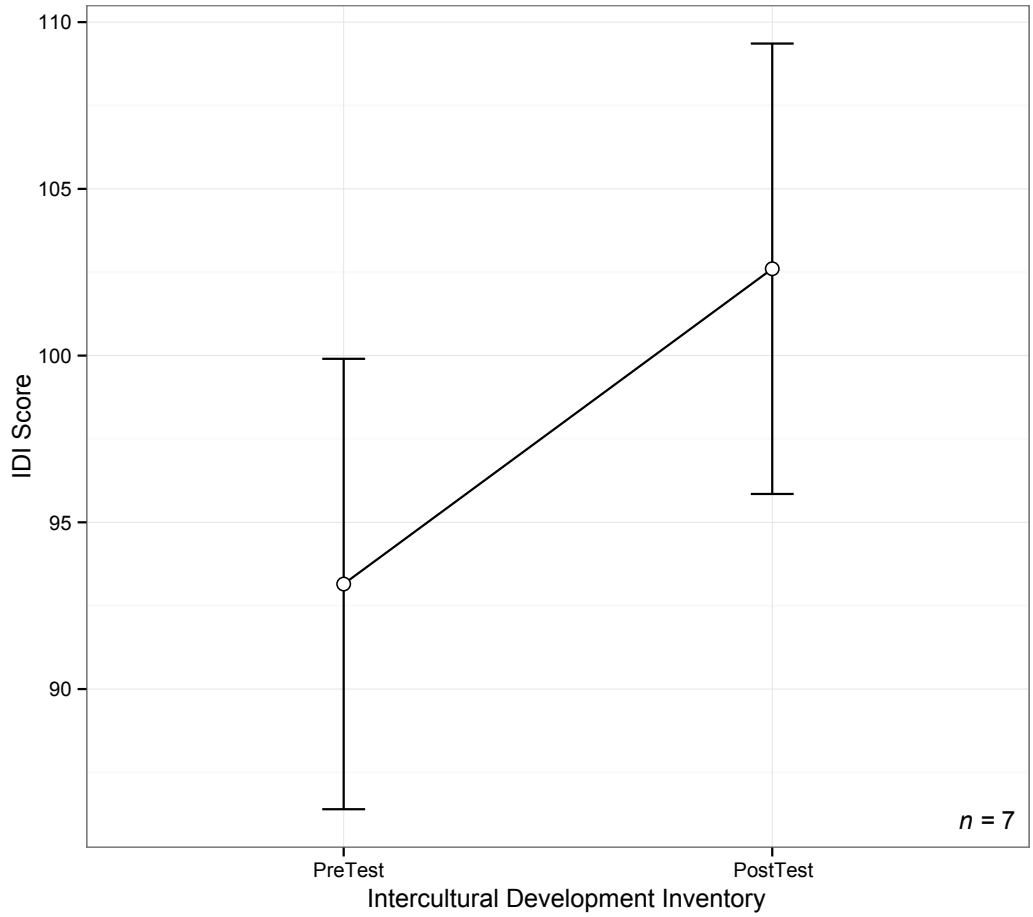


Figure 2.4. IDI developed orientation differences (n = 7) pre- and post-test show with a CI ±6.75 100% of the students made significant shifts with one shifting negatively.

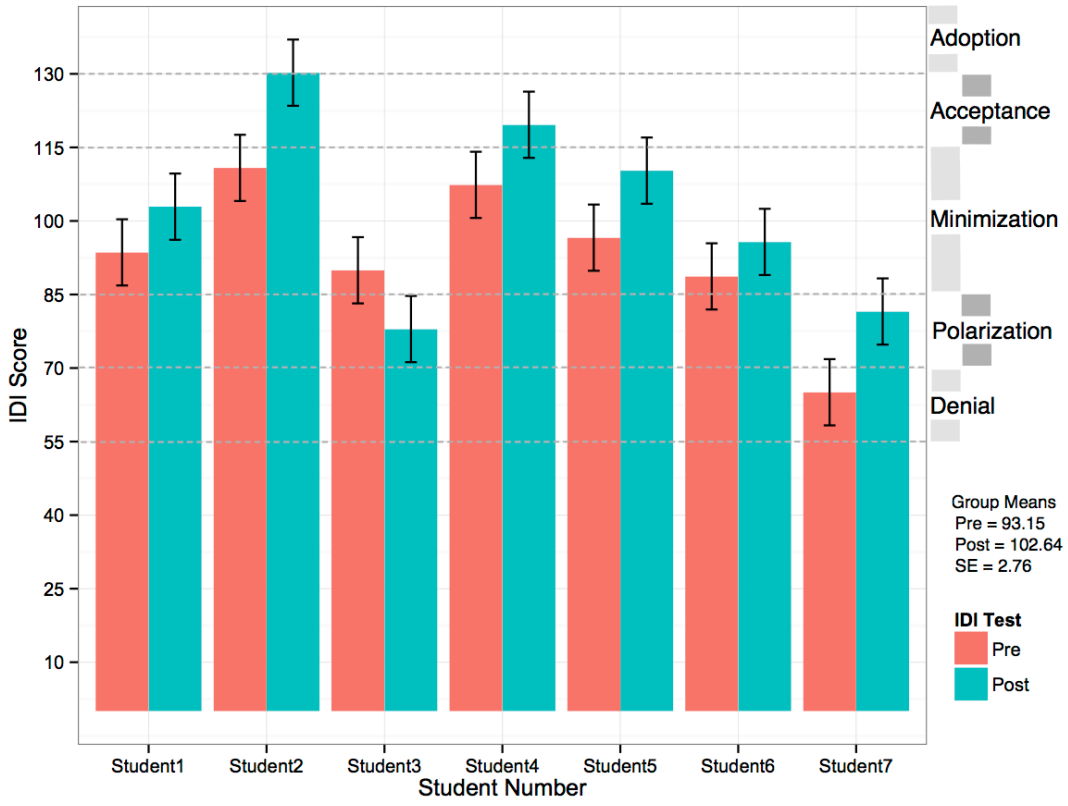


Figure 2.5. Six of seven students showed a significant positive shift in their developed orientation differences (n = 7) as illustrated by pre-test minus post-test with a CI ±6.75.

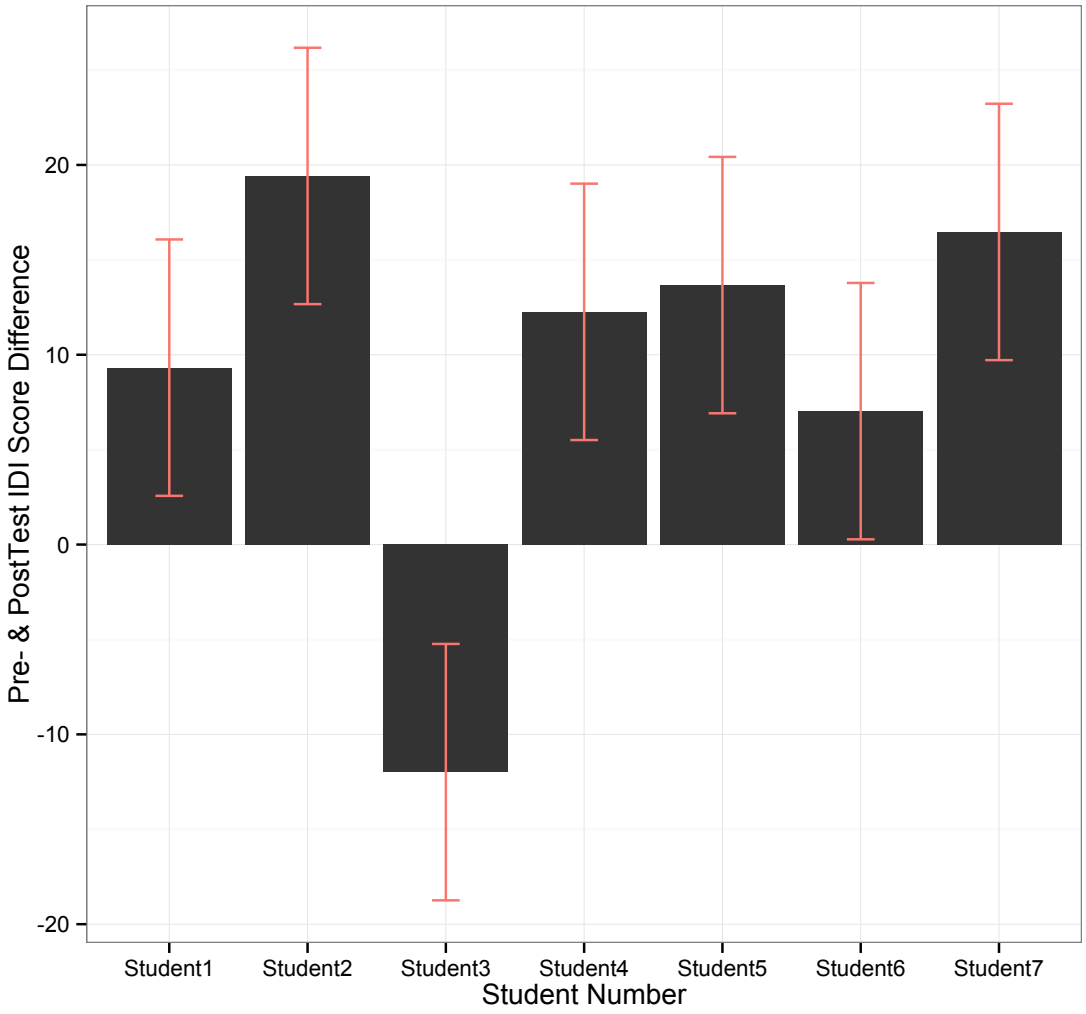


Figure 2.6. Four out of seven students showed significant decreases in their orientation gap, one's perceived orientation minus their developed orientation.

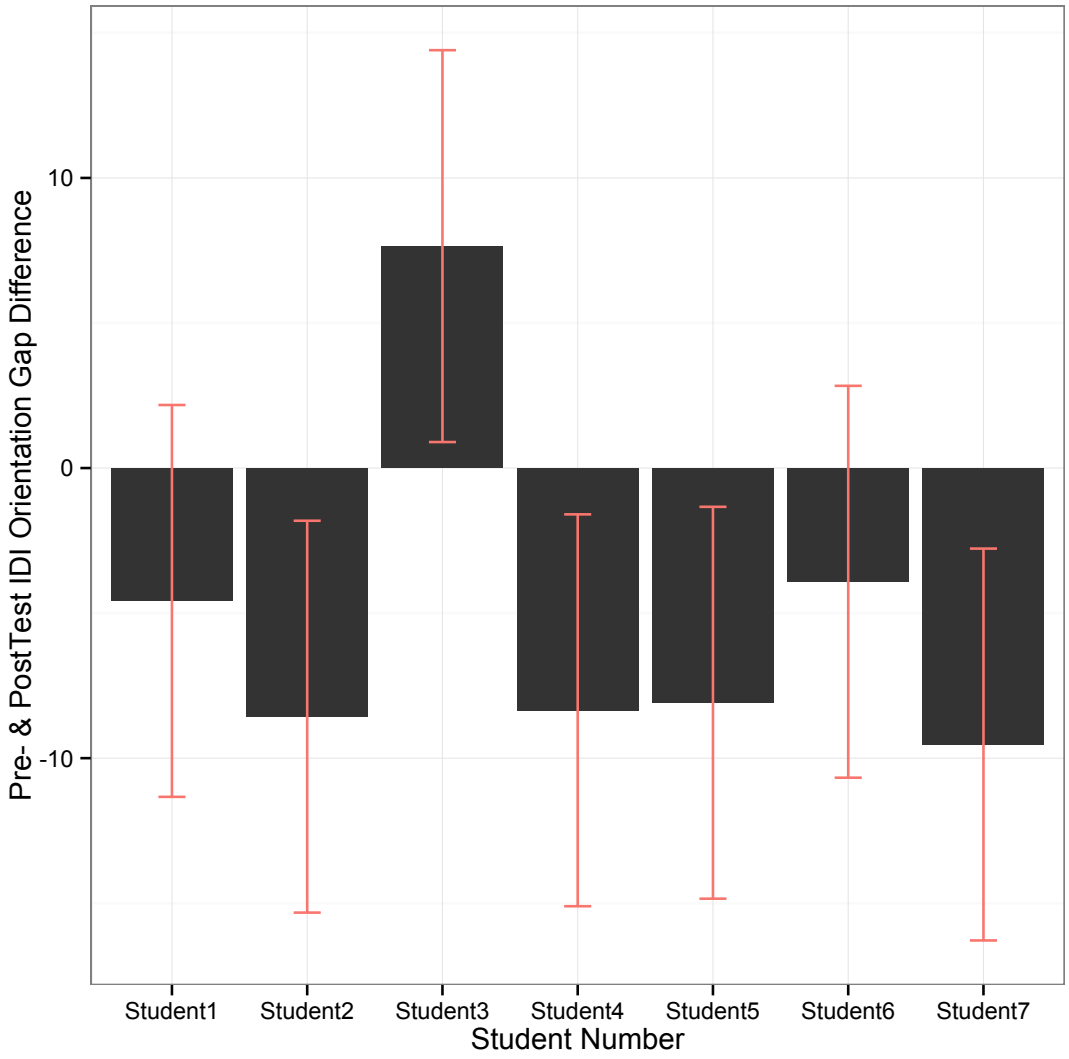
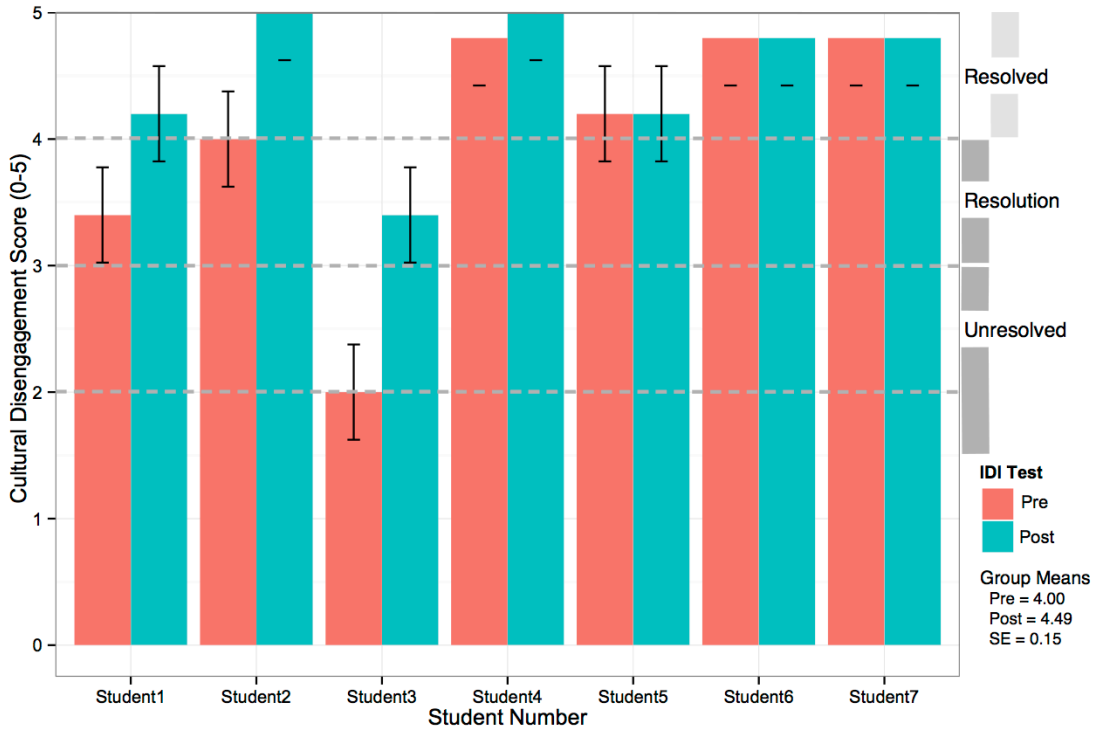


Figure 2.7. Every student was more culturally resolved at the end of the course than the beginning with 85.5% of students reaching the resolved category.



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Appendix

The following are other publications that were authored during the masters degree.

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