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A Geospatial Online Instruction Model

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Abstract

The objective of this study is to present a pedagogical model for teaching geospatial courses through an online format and to critique the model's effectiveness. Offering geospatial courses through an online format provides avenues to a wider student population, many of whom are not able to take traditional on-campus courses. Yet internet-based teaching effectiveness has not yet been clearly demonstrated for geospatial courses. The pedagogical model implemented in this study heavily utilizes virtual classroom software. Short lecture video segments coupled with lecture presentation files and textbook readings are effective tools for teaching geospatial theory. Detailed laboratory instructions, video clips and screen captures of important laboratory exercise steps, and discussion board posts about laboratory steps can substitute face-to-face interactions that occur in an on-campus geospatial course laboratory environment and can help the online student understand complex geospatial analyses. Analysis of student tracking on the virtual classroom suggests that the proposed pedagogical model is an effective, satisfying, and rewarding learning strategy. The distance learning model is disadvantageous to the instructor because more work is

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needed up front. However, once the course has begun the instructor benefits by having a more flexible teaching schedule.

Keywords: geospatial, distance learning, GIS, virtual classroom, mycourses

Introduction

Distance learning (DL) or education is any education done where there is separation of teachers and students, which may or may not have synchronous communication (Phipps et al., 1998; Martin, 2005). Distance education has been around since the implementation of the postal service, when colleges began offering correspondence courses (Phipps et al., 1998). Today the Internet, global information technologies, and other rapid technological advances have allowed DL programs to evolve to use video lectures, and real time lecture broadcasts (Skopek and Schuhmann, 2008; Valentine, 2002; Jiangy and Yan, 2009). Recently, distance learning programs have become more popular, more diverse and have expanded to more specialized fields (Jiangy and Yan, 2009, and Wright et al. 2009). Some programs refer to the method of instruction as "online instruction" to illustrate that on-campus students may be registered within distance courses though they are not technically 'distant'.

The geospatial field, including geographic information systems (GIS) and remote sensing, is rapidly growing because geospatial skills are in high demand (Gewin, 2004). As the demand for geospatial skills increase, numerous national and international institutions have started to offer geospatial distance learning programs. Questions arise, though, about how to develop an effective model for teaching geospatial courses that utilize a complex suite of software, that teach quantitative spatial skills, and that rely on visual-based learning. Not only do students have to learn geospatial software in a geospatial course, but they also have to learn how to think spatially, such as understanding concepts of scale, and this can be especially difficult for students that do not have a geography or earth science background. These challenges make geospatial courses difficult to teach in an on-campus setting, and it is even more challenging to teach through a distance education platform. Given these challenges, is there a model that could be used to effectively teach geospatial technologies through online instruction, and if so is this model effective? The purpose of this paper is to present a distance learning geospatial pedagogical model and to evaluate it effectiveness though quantifying student learning behaviors.

Background

As distance learning programs have grown and become more available, the number of students participating in distance education has substantially increased. In 2007-08, one in five undergraduate students took at least one distance learning course as part of their studies; this is up four percent since 2003-04 (Aud et al., 2011). Graduate level distance offerings are also increasing, with over 22 percent of four year universities offering programs at this level in 2003(Aud et al., 2011). In addition to on-campus students, distance learning courses have been very appealing to nontraditional students. Typically nontraditional students represent the bulk of the distance learners because they often have difficulties attending on-campus courses due to career, family or lack of their desired courses at local institutions (Skopek and Schuhmann, 2008). The need for assessment of distance education has grown due to national trends to assess program quality (Banta, 2007), and to adhere to federal standards (Shelton, 2011).

People are often skeptical about the quality of distance education, and often it is believed that online instruction is inferior to traditional classroom education. There were worries within geography that if educators rely too much on distance learning techniques, the discipline would risk losing “collective souls in [a] rush to convenience, cost effectiveness and accountability” (Gober, 1998). These skepticism and worries were not ignored. Several studies have assessed various aspects of distance learning (Shelton, 2011; DiBiase and Rademacher, 2005; Palloff and Pratt, 2001; Wright et al., 2009). Shelton (2011) looked at 13 different methods used to assess online learning and found that many studies have listed institutional commitment, support, and leadership as some of the important indicators of a quality program. In addition, student satisfaction was also listed as an important assessment measurement as it plays a large role in the overall quality, retention and overall success of an online program (Shelton, 2011). Studies have also found generally higher faculty workload in distance learning as compared to workload in a traditional class room (Schifter, 2000; Rockwell et al., 2002; Solem, 2001; DiBiase and Rademacher, 2005).

Teaching geospatial courses using an online platform creates additional difficulties with regards to software and hardware issues, which include obtaining geospatial software, troubleshooting technical issues with geospatial software, compatibility issues, and in general, degree of computer proficiencies of the students. Yet amidst these difficulties, there is a growing need for education in geospatial technologies and a growing popularity of DL programs. Several institutions already offer courses in geospatial techniques via an online learning platform (Liimakka et al., 2010;

Wright et al., 2009 and Schweik et al., 2008). These courses utilized both proprietary software as well as open source software programs, such as GRASS, ESRI products, and Idrisi among others (Schweik et al., 2008).

As an example, the Department of Geosciences at Mississippi State University offers five online DL geospatial courses, including principles of GIS, remote sensing of physical environment, advanced GIS, geodatabase design, and special topics courses in the geospatial sciences. These courses can be used to satisfy the curriculum requirements for a Geospatial and Remote Sensing Certificate program. With many geospatial courses offered via an online instruction format, studying the effectiveness of these courses can contribute to the collective knowledge of online instruction in general and can provide insight into how to effectively manage and implement a geospatial DL program.

Methods

Firstly, this study proposes a pedagogical model for teaching online geospatial courses. Secondly, the effectiveness of this model is critiqued via tracking the online course student behavior and student surveys.

The pedagogical model was initially implemented in the Fall 2006 semester. Since its initial offering, numerous changes have been made incrementally. In addition to geospatial software program changes, methods in delivering course materials to students and blueprint designs on setting up virtual classrooms have been refined. The current model is based on documenting past mistakes and successes, reviewing student evaluations, and testing course efficiency with regards to delivering content and grading online submission of assignments and tests.

The student tracking tool within MyCourses was used to quantify the amount of time students devoted to each of the tools, including watching videos, reading lecture presentation files, reading/downloading/uploading assignments, sending/reading emails, posting/reading discussion threads, monitoring grades, and working on assessments. The tracking tool was implemented for nine (9) different online geospatial courses that were taught from Fall 2008 to Fall 2011. This included a total of 102 different student tracking reports spread among courses in GIS, remote sensing, geospatial technologies, and geodatabase design. Note that students in the program took several geospatial courses simultaneously, and thus the tracking numbers are not independent across courses.

This study also used questionnaire surveys and an analysis of student use of the virtual classroom to examine areas of instructional design and teaching and learning effectiveness. The survey questionnaire included 32 questions on demography, course design, teaching and learning effectiveness, technology, assessment, and institutional support. Among them, twenty-six survey questions were on various dynamics of the DL program such as effectiveness of lecture and lab format and delivery methods, difficult level of the DL course compared to traditional classes, adequacy interactions between students and instructor, support for technical issues, support for administrative issues etc. Student stratification was ranked using the Likert Scale. Remaining questions were on demographic characteristics of the respondents. There was one open ended question for any additional comments the students were willing to make. The survey was approved by the institutional review board, and was administered only to the students who are 18 years or above. Respondents remained anonymous. Students were notified about the survey and reminded to participate via a university issued email address, not directly tied to their digital classroom. The survey was administered on a free online survey website, www.kwiksurvey.com. The survey was sent to approximately 60 previous and current students.

Results and Discussion

A Pedagogical Model for Teaching Online Geospatial Courses

The Geospatial Online Instruction model consist of six elements: the virtual classroom (MyCourses), the data vault for large file storage (MyMedia), the student, the instructor, the software provider, and the institution Information Technology Service (ITS; Figure 1). The courses are subdivided into a lecture component, where geospatial theory is taught, and a laboratory component, where students learn how to apply the theory to and use the software.

Software: Before the start of the semester, the instructor contacts the software provider to request copies of student versions of the software. The software is shipped to the instructor, and then the instructor mails a copy to each registered student. Students can also individually request software directly from the company with the instructor's permission. Most software companies provide free student evaluation copies to universities that have an existing contract or they offer software at an educational discount. The software typically has a 1-year license, and during that time it is possible for students to complete three consecutive semesters of course work. Geospatial certificate programs often include a minimum of 15 semester credit hours of course work, which can all be completed within the duration of the student evaluation license agreement.

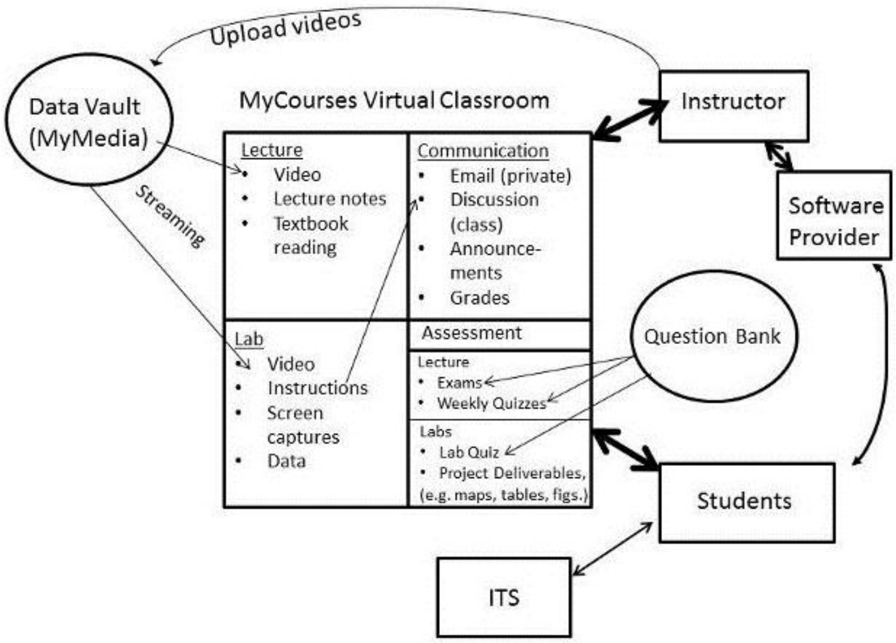

Figure 1. *Diagram outlining the pedagogical model for online geospatial courses*

Video Lectures and the Data Vault Server: Lectures and laboratory demonstrations are filmed using a combination of video camera and webcam. The video camera is used to film lecture introduction and segments of the lecture or laboratory that require chalkboard drawings (e.g. formula calculations, drawing diagrams). A webcam that is integrated into video-capturing software is used to film lecture and lab presentations with text, graphics, software examples, and pictures. Both webcam and video camera clips are spliced together in with video-editing software. The lecture videos are divided into sections approximating 20 minutes. As an example, a lecture on vector analysis would have 20 minute video segments for each of the following: querying, buffering, overlay operations, and geoprocessing. Laboratory videos are similarly subdivided into sections, such as a segment showing steps 1 – 10 of the instructions, another segment that shows steps 11 – 20, etc. The 20 minute time frame works well for student because it makes downloading or streaming video files a lot easier. Video files are then uploaded to the data vault server (MyMedia). The advantage of the data vault is that it allows faster and easier file management. Working with large, complex geospatial file types (e.g. Shapefiles and Imagine files) in a web-based platform, such as in MyCourses, is cumbersome. In the authors' experience, it is much easier to upload and manage files on a server and then create web-links within MyCourses than to upload files directly to MyCourses. Using the data vault may also reduce costs associated with uploading large amounts of data to an educational software website.

Virtual Classroom: The virtual classroom (Blackboard MyCourses) consists of four major sections: Lecture materials, Laboratory materials, assessment tools, and communication tools. The first three of these sections are set up prior to the semester start date. There are also minor sections consisting of the syllabus and grade tools. Lectures materials are placed into learning modules, and the learning modules are selectively released based on the dates in the syllabus. The lecture learning modules include a web-link to the lecture videos, copies of the lecture presentation file in PDF format, textbook reading assignment lists, and links to the lecture quiz. The laboratory materials are similarly placed into learning modules with selective release dates. Because laboratory exercises are cumulative, the successful completion of the previous laboratory assignment is required before new labs will become available. The laboratory learning modules include the instructions (PDF format), links to the video files that demonstrate key steps, presentation files with screen captures of important steps, links to the lab quizzes, and copies of the data. Large datasets (> 10 mb) are uploaded to the data vault where students can download directly. In an on-campus geospatial course, students are able to interact face-to-face with instructors or teaching assistants (TA's) during the laboratory exercise. For the online learner, the face-to-face contact is not possible, and this necessitates having more detailed instructions. Further, the laboratory video segments help guide students through the exercises similar to how the instructors and TA's would help within an on-campus course.

The course grade is based on lecture assessments (quizzes and test) and laboratory assessments (assignments and lab quizzes). A question bank is created so that multiple versions of quizzes and test, for both the lecture and laboratory components, can be generated with questions of similar difficulty level and covering similar concepts. Having a deep question bank with multiple versions of questions helps minimize cheating and collusion. For the lecture component of the grade, students complete weekly quizzes that have questions based on the lecture materials. The quizzes are collectively a minor component of the overall grade (<15%) and treated as study guides. Students are permitted to use their notes to take the quizzes. This is done by setting an unlimited time duration for the quiz, yet quizzes are still due by a certain date. Tests are used to assess learning of the material. They are heavily weighted (at least 50% of the grade collectively) and they are closed-note and closed-book. This is achieved by setting strict time limits (60 minutes) on the exam, which prevents students from being able to look up answers. The short time duration coupled with a deep question bank obviates collusion. The laboratory portion of the grade comes from both turning in a project (map, figure, graph, or table) and by submitting a quiz on the laboratory assignment. The laboratory assignments follow the lecture outline, so a lecture on vector analysis will be accompanied by a laboratory assignment that teaches how to query, buffer, overlay, and geoprocess spatial data. Multiple versions of the laboratory assignments are created to prevent collusion. As an example, a particular laboratory exercise in a GIS class has students create an index raster model for reintroducing an endangered animal into a specified area. Each version of the laboratory exercise has different model criteria, including having different variable weights or having different preferences for elevation, land cover types, distances from roads, etc. The data provided by the instructor are the same, but each student or group of students will have a unique variable combination. This helps ensure that students are not copying work from others. With large enrollments, students can be randomly assigned to a particular version of the laboratory, and this grouping can be made to change for each exercise. At the conclusion of a laboratory exercise, students will have produced several deliverables, including a final map and possibly figures, graphs, and tables. These are all inserted into a lab report, which is then uploaded to an assignment dropbox. Detailed grading forms are used as the rubric for assessing the lab reports; the grading forms can be viewed by the student prior to submission so that they have a clear understanding on how the project will be graded. In addition to the laboratory assignment, students submit a laboratory quiz that has questions based on the outcome of specific steps. For example, in a laboratory exercise based on performing spatial queries, students may be asked how many toxic waste sites are contained within as specific hydrological unit. Collusion and cheating can be minimized by generating multiple versions of the laboratory quiz questions. Using the previous example, different questions can be created that require querying toxic sites within differing hydrological units. Or, multiple versions of a question can be created by modifying the query criteria for the same unit (e.g. finding toxic sites that are within 100 m of streams, 200 m of streams, etc.). The laboratory quiz questions are also based on concepts learned in the laboratory exercise. As an example in a remote sensing class, students may be asked to compare the results of supervised and unsupervised classification schemes and to discuss the reasons for the differences.

Student interactions with the instructor and classmates occur via the communication tools. Emails are intended for private communications. The bulletin board within Blackboard is used for general class discussions. Discussion threads are created for application of concepts to real-world scenarios. Also, discussion threads are created for each laboratory exercise. Here, students can post questions about a particular laboratory instruction or post solutions to software problems. These discussion threads allow students to help each other as they would if they were in an on-campus geospatial laboratory environment. Moreover, the discussion posts are beneficial to the class as a whole because it allows for some student questions to be resolved during instances when the instructor is not logged into the virtual classroom (e.g. at night or on weekends). A student may have found a solution to a software glitch for which they would share their advice with the class at large. This helps the instructor by providing a solution to the class when they are away from the computer and it reduces the volume of emailed questions. Discussion threads also help students learn from each other. If one student has a question about a concept that they post, then others might able to offer an explanation. Because the discourse is not limited to a typical work week schedule, students can help each other during periods when the instructor is away from the computer. Additionally, discussion threads can significantly increase student interactions and make the course as personable as an on-campus class (DiBiase, 2000).

Role of the Instructor: Instructors are strongly recommended to develop the online class before the course start date. Syllabi, lecture materials, laboratory materials, development of question data bank, creating quizzes and test, and setting up learning module, data vault, and assessment properties (e.g. release dates, grading forms, point values) should be nearly complete before the semester begins to ensure that materials are available to the online learner within a reasonable time frame. Without advanced preparations, there is not sufficient time in the semester to upload lecture or lab materials, to edit quizzes and test, or to troubleshoot laboratory exercise. Ideally once the class begins, the instructor should just have to focus on communication with the students and grading assessments. Typically, the online learner that takes a geospatial class is a non-traditional student that is currently employed. For students with fulltime jobs, much of the course work is completed at night or on the weekends, and the online learner needs immediate access to course materials during periods when the instructor is away. Depending on a the type of job or familiar obligations, there may be periods of time when students have more available time to devote to the course and times when their job or family requires their full commitment. For example, students that are K-12 teachers may want to complete as much of the online course work as possible earlier in the semester before they have to start their state testing. It is important, then, for an online instructor to recognize the punctuated and episodic dynamics of the non-traditional online learner and to have course materials more readily available than they would for the traditional on-campus student.

Role of the Student: Students must recognize that they are required to check the virtual classroom website daily. For an online student to be successful, they must be aware of due dates and they must be able to completely understand how to turn in assignments and to take quizzes and test. It has been within the authors' experiences that students who do not remain in contact or that have limited access time on the virtual classroom greatly underperform. Instructors should track and quantify virtual classroom login times and make efforts to contact students that are not fully participating. To help ensure that students understand the virtual classroom set up, the methods to submit assignments and to take quizzes and test, the due dates, and the course policies (e.g. honor code, late assignment, makeup policies), students must initially take a syllabus quiz. Release of lecture and laboratory materials are contingent upon a successful completion of the syllabus quiz, which requires students to study the course syllabus and to answer quiz questions on course protocol, communication rules, due dates for assessments and assignments, and other important course content.

Institutional Information Technology Service: Student questions pertaining to problems with the virtual classroom website or the data vault website can be addressed by the institution's ITS.

Critique of the Geospatial Online Instruction Model: For the student, the most challenging aspects of this geospatial pedagogical model are software related issues. The onus is on the student to successfully install the software on their own computer. However, technical issues can arise stemming from variations in student computer setup or operating system. The software provider, and in some cases the institution's ITS, can assist with the technical issues. This removes this burden from the instructor. It is necessary, then, that students begin the software installation process and complete the first laboratory assignment as soon as the course begins to ensure that the software and computer setup are working properly. Aside from the technical difficulties, the second biggest challenge is completing the laboratory exercises. As stated, the bulk of the instructor's work is setting up detailed laboratory instructions before the class begins. The online learner needs more detailed instructions and screen captures of important steps to offset the lack of face-to-face contact. Video segments of laboratory steps also help guide students through the exercises. Providing these detailed resources is time consuming for the instructor, but it substantially reduces the volume of student questions via email. The Geospatial Online Instruction Model does provide many benefits to the student. Primarily, it provides access to geospatial courses and geospatial skill sets to students who might not be able to attend on-campus courses. Another advantage is that the online instruction format appeals to certain types of learners. Some students perform better when they are allowed to work at their own pace, when they are not distracted by their classmates, or when they are allowed to work on their own schedule (e.g. people who perform better early in the morning or late in the evening). The online instruction course, especially the laboratory exercise, can be completed in a more comfortable setting (e.g. in a student's apartment) which may also help facilitate learning.

For the instructor, the biggest disadvantages of an online instructional geospatial course are setting up the materials in advance, creating multiple versions of assessments, and creating deep question banks. The majority of the work (at least 75%) is put into the class before it begins. Online instructional courses require more development time than a traditional on-campus class. A secondary frustration comes from addressing technical issues about the software, the virtual classroom website, or problems with the video streaming. Most of these technical issues can be assisted by the software company support service or the institution's ITS. There are many advantages, though, of teaching a geospatial online instruction course. For one, the instructor is able to share their knowledge and experiences to a wider student population and to a student population that they may not have the opportunity to work with in an on-campus environment. Online instruction also allows for better quality lectures. Because the lecture materials are prepared in advance, instructors can edit and rehearse lecture concepts before they are delivered. Additionally, once the course is setup properly (uploading videos, creating question banks, setting assignment properties, creating grading forms, etc.), it can be saved and used again with only minor modifications. Perhaps the biggest advantage is that it allows the instructor to teach the class wherever there is a connection to the internet. Because most of the materials are prepared in advance, the instructor role once the course begins is mostly grading and communicating with students. Instructors can effectively teach the class while away doing field work or studying abroad. Instructors that commute long distances to their college or university would benefit because they could substitute an online class for one of their on-campus teaching assignments. They could teach the class from home and reduce the number of days needed to commute. Faculty with personal needs (e.g. faculty wanting to spend more time with children, pregnant faculty, or faculty needing to care for an injured or sick loved one) could effectively teach a geospatial course while attending to their familiar obligations. The flexibility on when and where to teach makes teaching an online course an appealing option.

Evaluation of Pedagogical Model

Course Activity Tracking: The student tracking tool in Mycourses quantifies students' activities on Mycourses. Time spent by students on a particular course tool could indicate rigor of the course and show the importance students attach to each tool. Certain aspects of the course, such as quizzes and tests, are required and they are time specific. Therefore, we can expect significant amount of time spent on these tools. Students spent on an average about 29 percent of the total time on the lecture presentation files. They spent only 14 percent of their total time watching lecture and lab videos. Students spent on an average 12.3 percent on discussion board and 11.5 percent on email tool. That means a total of 23.8 percent time was spent on interacting with other students and instructors (Figure 2). This result removes the misconception that interactions are less frequent in DL programs.

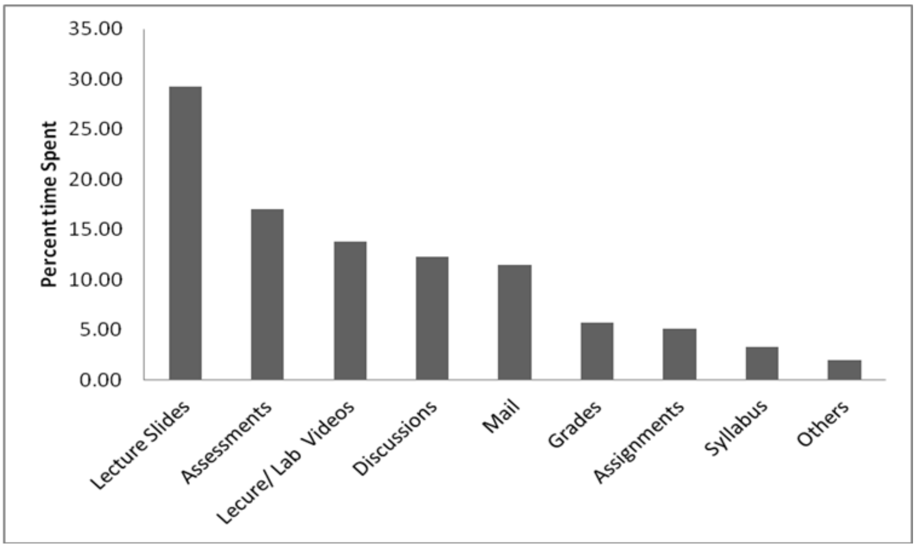

Figure 2. *Average time spent by students on various tools on MyCourses*

Student Survey: To evaluate the online pedagogical model, previous students were asked to fill out a survey. However, only 6 of the 60 students who received the survey request responded despite numerous attempts to solicit returns. Although the number of respondents is too small to be used independently to evaluate the geospatial distance learning model, the survey results help corroborate the student tracking data. Before discussing the survey results, it is prudent to disclose the population characteristics of the respondents. All respondents already had a bachelor's degree at the time the geospatial DL courses began and they were all employed while taking DL courses. Four out of six respondents were female with an age range between 26 and 45 years. The top reason for taking DL course according to respondents is convenience and flexibility followed by the opportunities for professional growth or promotion in their existing job. Time constraint to attend a traditional classroom course is another commonly cited reason for taking a DL class. This result confirmed that distance learners are different from traditional students in terms of their age, experience and maturity level. They have already come of age, and most are immersed in professions and possibly families and other things that keep them away from the traditional classroom. They are motivated learners and they need a different kind of relationship with educators (DiBiase, 2000).

Even though the tracking indicated that only 14% of the time was spent watching course videos, all respondents believed that the videos presentation of lectures and lab helped them to understand the geospatial concepts. Respondents of our survey did not believe that learning new software was the biggest challenge. This indirectly indicates that the laboratory instructions, videos, and screen captures were effective in communicating how to perform the geospatial processes. All respondents agreed that there were adequate student-student and student-instructor interactions and that email and discussion boards were effective tools for interaction. This result agrees with the student tracking data. Students spent nearly equal amounts of time communicating as they did watching the video lectures, and the combination of the two teaching tools seems to have benefited their understanding of geospatial concepts.

Conclusion

Distance learning programs are often celebrated for their potential to expand higher education to people from different age, gender and class who have zeal for education, but could not have access to traditional class-room based education (Wright and DiBiase, 2005). Enrollments within DL courses have greatly increased, and it is expected that this trend will continue. In particular, the growth of the geospatial field has necessitated a demand for online geospatial courses because much of the potential student population is not capable of attending traditional on-campus courses. At the same time, there are concerns that DL courses cannot be successfully implemented to teach the geospatial sciences.

In this paper, we presented an online geospatial course pedagogical model, which has been developed, refined, and implemented over a five year period (Fall 2006 to Fall 2011). The model consists of a virtual classroom, a data vault for file distribution, students, instructors, software companies, and an institution's ITS. The virtual classroom houses lecture materials, lab materials, assessments, and communication tools. The lecture materials include a series of short (20 min) video clips, lecture presentation files, and textbook reading list. The laboratory component of the virtual classroom contains exercise instructions, video clips and screen captures of important steps, and data. Video clips for both lecture and the laboratory are housed in a data vault and links to the video files are created in the virtual classroom. The geospatial online learner is required to complete assessments for both the lecture and laboratory components of the course. The laboratory assessments include submitting deliverables, such as a map or table, and submitting a laboratory quiz. Multiple versions of the laboratory assignments and quiz questions are needed to remove cheating and untoward collusion among students. Deep question banks with numerous questions also obviate cheating on lecture tests and quizzes. Discussion posts among students can help the learning process by having available solutions to common problems with the laboratory exercises or providing alternative explanations. The discussion posts facilitate student understanding and minimize frustrations because solutions to problems can be presented during periods when instructors are away from the virtual classroom. In this model, the majority of the instructor workload occurs before the class begins. However, once the course is in session the instructor's obligations switch to communicating with students and grading assessments.

The above model does create a higher workload for instructors. Laboratory exercise needs to be more explicit because students are not able to seek immediate help as they would in a traditional geospatial laboratory setting with an instructor or teaching assistant present. The use of video clips and screen captures can augment the exercise instructions, however, and reduce the amount of confusion and the volume of email traffic. Developing a deep question bank can also require a large input of time, but it is necessary to minimize cheating. Given the above, the instructor will need to invest a lot of time to develop the online geospatial course. With this being said, the model does have many advantages for the instructor. Once the course is developed, it can be reused with slight modifications and it affords the instructor the ability to teach the class remotely and on a flexible schedule, which might increase research productivity or help with commuting and familiar obligations.

Students can also benefit from the proposed online geospatial course pedagogical model. The DL format opens more avenues for non-traditional students to learn geospatial skills and it may help students that learn better on their own. A student survey was conducted and respondents generally agreed that the geospatial model was a successful design. According to the respondents, the most important aspect of the DL course was that it gave them the flexibility and convenience to take the course while working full time, as opposed to taking the class because they wanted a particular instructor or they had loyalty to a particular university. Tracking of student usage revealed that students are actively using each of the components of the virtual classroom. The tracking also shows that time spent emailing instructors are not dominant. Instead students are spending twice as much time on the lecture and lab materials. This is a testament to the abundance of lecture and lab materials, such as the video clips. The results of both the survey and student tracking suggest that students are learning and benefiting from this pedagogical model.

According to the student data, the hard work and effort to develop refine, and implement a geospatial course seems to have paid off. However, there is need for improvement. One limitation of this study is that only 10% of the former students responded to the survey. Continued monitoring of student evaluations and of student tracking is needed to develop a larger sample size. A larger sample size may also allow for the comparison between distance learning course and on-campus teaching effectiveness. Yet, it is encouraging that the respondents collectively agreed that taking a geospatial course via the Internet was a successful experience. The future for offering geospatial courses via an online platform is promising.

Biographical statement

Dr. John. C. RODGERS III is an associate professor in the Department of Geosciences at Mississippi State University. He is a geospatial biogeographer with research interest in mapping and quantifying invasive species population changes on islands. He has taught on-campus GIS courses since 2002 and has taught both on-campus and distance learning GIS classes since 2006.

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