Bridging the GAP - Geomatics and distance learning

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Presented at
ESRI Education User Conference 2004
San Diego, California, August 7–10, 2004

ABSTRACT

Geomatics is the measurement science that serves as an important foundation in the development of GIS applications. The Geomatics Program at Troy State University, Troy, Alabama recognizes this and has included GIS courses into its curriculum. The Geomatics Program is available in residence and we are in the process of investigating a model and the issues in making the course available online. The online development of Geomatics courses has various obstacles and is seen within a supporting context of bridging the gap between the survey and GIS professions. In this paper is discussed the issues and solutions intrinsic in the model. One of the main challenges in the model is student access to software such as ArcGIS, and access to survey equipment. This paper outlines these challenges using the undergraduate Geomatics courses.

Keywords and phrases: Distance learning, model, Geomatics, GIS, Bridging the gap

1 Introduction

The World Wide Web (WWW) has within the recent decade been recognized by professionals as an important medium which complements their business functions. The use of the traditional use of telephones, fax machines, postal services have been impacted by the WWW and as a result the suppliers of these traditional form of communication has been forced to develop new strategies, if they were to remain in business. The development of the WWW has influenced new initiatives such as e-commerce, distributed processing, information sharing, low cost real time communication, education, and such like.

The method of education instruction has over the years moved from instructor-led courses to web-led courses. A hybrid of instruction is that of self-study workbooks. The instructor-led courses are ideal for those who need to learn the most in the shortest amount of time. This includes courses combined with personal delivery, hands-on experience, and class participation to create a rich learning environment. The web-based courses are aimed to motivated learners who need flexibility in their training schedule or location and to those who cannot afford the time away from work to attend the traditional class settings. The self-study workbooks are ideal for highly motivated learners who can independently complete the work and apply what they have learned with little outside support.

One of the growing businesses via the WWW is education. WWW users now have the choice to write for a tertiary education degree at a tertiary education institution or online offered by institutions offering the same degree course content via the WWW. The traditional techniques of delivering course materials to students is instructor-led course in residence held at institutions when compared to the web based courses that contained the same material as if in residence. The use of self study workbooks is used both in residence and online, but such workbooks typically would be required further guidance and as a result further instructions are required.

Bridging the gap between surveyors and GIS specialist has in recent time been a concern by the GIS community. The general consensus is that the two professions are dependent upon each other. Ideally, both professions need to have a better appreciation of the concepts and methods which they adopt to achieve their everyday business operations. This concern can best be addressed at tertiary institutions that teach GIS and Surveying such that the link between the two professions can be effectively identified. The GIS specialist needs to have a better understanding of the practices adopted by Surveyors while Surveyors need to better understand the practices adopted by GIS Specialists. This is best addressed through the education of the professionals.

In this paper a suitable online model for the degree program offered at Troy State University (TSU) in the Geomatics Program is presented. Research is needed to determine the best model for the Geomatics Program. This paper presents the investigation and findings associated with the definition of a suitable online model for the Geomatics Program. The investigation involves current Geomatics online programs offered by other universities and the classification of programs based on the different existing models. The purpose of this paper is to identify some of the models and approaches adopted my some universities in America, and relate them to the generic models presented in Mason (1998) work. The background research presents universities in the US that are partially facilitating DL in Geomatics. There are a number of issues associated with the provision of this Geomatics from a distance. These issues are presented in this paper which has the following structure: Section 2 presents DL models; Section 3 presents some examples of existing DL models; Section 4 presents DL technologies; Section 5 presents the approach being adopted by the Geomatics Program at Troy State University; Section 6 presents TSU's generic online model; and Section 7 presents the conclusions of this paper.

2 DL models

There are various online course models being used by tertiary institutions. The models they adopted are influenced by the course contents, resources available, expertise, and experienced of the course developer. In this paper a framework is being investigated that will be suit the courses offered at the Geomatics Program in TSU. An understanding of the various models is needed and a qualitative evaluation is done to assess the best model.

The different approaches to distance learning are influenced by the advances in computer technology and for some time, through the popular use of the Internet. Early online teachers have been pondering on the best structure to deliver a course. This is an important consideration in delivering a course (even in residence) but it becomes more critical when offered online because of the different pace at which online students may cover the material. Consideration may be taken so that changes in the structure do not affect students who may have already covered any changed portion of the material. Hence it is important that the structure of courses is very well thought out and does not affect students. Provisions are needed to rectify any problem that may evolve because of a flaw in the structure and discussions online is always necessary. Many instructors recognize that the generation of discussion online requires careful planning and structuring.

2.1 Education approaches

Mason (1998) presented a simple framework within which a very wide range of existing online courses can be considered. He identified five educational approaches which should be adapted, re-discovered and applied within the context of courses being made available online. The first educational approach is structured discussions. This involves group communications with the students at a distance. This is certainly a challenge because it will mean that all the students and the instructor would be required to meet at a specific time, and this will defeat the would purpose of having an online course if the student is expected to attend these discussions. Mason's (1998) recommendation is that structured discussions should be left to the students requesting it and be left upon interested students to choose to attend the discussion sessions.

The second educational approach is collaborative activities which involve the innovative ideas of getting groups to work together from a distance. This can be facilitated by the instructor providing course specific material which can be downloaded by the students or the students are guided to access the reading material through library search via

the Internet. Student groups will then be required to construct group web sites and present their group work or alternatively submit their group report via a white paper. If the group web sites are the preferred choice of submission, then other group can comment and also review the submitted work from their peers, instead of only the instructor review.

The third educational approach is online assessment which includes the ease at which the assignments, self tests, and examinations are easily taken online. Depending upon the distance education software being used and the course being offered online, the grading of student submissions can be electronically done. Multiple choice examinations can be electronically evaluated, however, essay type questions do require the instructor's input to evaluate the answers submitted by the students.

The fourth educational approach is interactive course material. This approach entails a range of videos, CD-ROMs, audio and text documents, and opportunities to interact meaningfully with the course content. This approach is more costly because students will be required to purchase the hardware used to store the course material, and also access the material stored on the various hardware. The fifth educational approach is an online a combination of interactivity in the learning process, the need of knowledge management skills for team works, and the move towards the resource-based learning rather than packaged learning that is defined by the instructor.

2.2 Online course models

Mason (1998) made use of the educational approaches to derive the framework of three online course models: Content and support model (CSM); Wrap around model (WAM); and Integrated model (IM). The CSM is the most extensive category of online course and it is one of the earliest models. In this model there is a separation of the course content and the tutorial support. The course content is typically delivered to the students in print via the postal service or through the Internet by downloading the course which includes the lectures and labs. The tutorial is delivered by email or by using Internet conferencing. Tutorial sessions implies that the instructor and the student need to be online at the same time, therefore an agreed time set must be set by the parties involved. Scheduled Internet conferencing defeats the purpose of studying at a distance because the student and instructor will have set time to communicate. In this model the use of Internet conferencing is flexible enough to be schedule and only when it is needed and in this way not on a set schedule. In this model there are rudimentary reports of collaborative activity amongst students. The reports usually present conflicts with learning the course materials and with the group collaboration online activities. The course content and tutorial support using this model is delivered by structured web pages.

The WAM defines courses which consist of tailor made materials such as study guides, activities and discussion that are wrapped around existing materials. The existing materials are by way of text books, CR-ROM resources or tutorials. The online interactions and discussions occupy about half of the students' time, while the predetermined content occupies the other half. This model allows students to interpret the course material for themselves. The students' freedom with the course material comes with it a level of responsibility of the students. The role of the instructor in this model is much more extensive than the CSM because it involves less pre-defined course material and much more incorporation from the discussions and activities. This can be an ideal model for research oriented degrees or graduate work. In this model there is also the consideration of real time online events to be included. For example, the use of screen sharing software to solve technical problems at a distance, or one-way audio lectures with accompanying over-heads is sufficient or with the notes to the overheads. This adds a live and real time dimension to the course. Student questions are submitted via email and responses are made via emails by the instructor.

The IM is the third model which is a combination of the first two methods. This model would seem as being the ideal in the sense it can be specifically tailored to satisfy the given context in which the courses are being delivered in a given program. That is, it can take parts from the CSM and WAM to come up with the best suited model for the given degree program. The main part of the course takes place online though discussion, accessing and processing information and carrying out tasks. This integration model is focused on creating a learning community. Based upon the three models the next section presents examples of existing online course which are in operation.

3.0 Existing online models

The following systems are reviewed and are categorized based upon Mason (1998) three models. The University of Phoenix[1] provides distance learning. Its online program provides many-to-many classes rather than one-to-one classes where each class has its own group mailbox. It is an electronic classroom, where communication between individuals is common. There is a group forum in each class where critical review is provided by the students themselves on their peer submission work. The forum is used to improve the quality of student work before finally being submitted to the instructor. Students have the ability to access the university electronic library. The benefit of the online program is that classes are offered one at a time and students are able to complete each course by being focused since there are no semesters. A class typically lasts five or six weeks. Students can sign on anytime of the day that best fits their schedule. In Figure 1 is shown the graphical user interface used in providing the courses online at Phoenix University. Use is made of Microsoft Outlook express. This is an effective approach for the University because all of the undergraduate online courses are degrees for business, health care, and management. The approach adopted here may not be totally effective within the context of Geomatics because of the need for practical use of equipments and high end software.

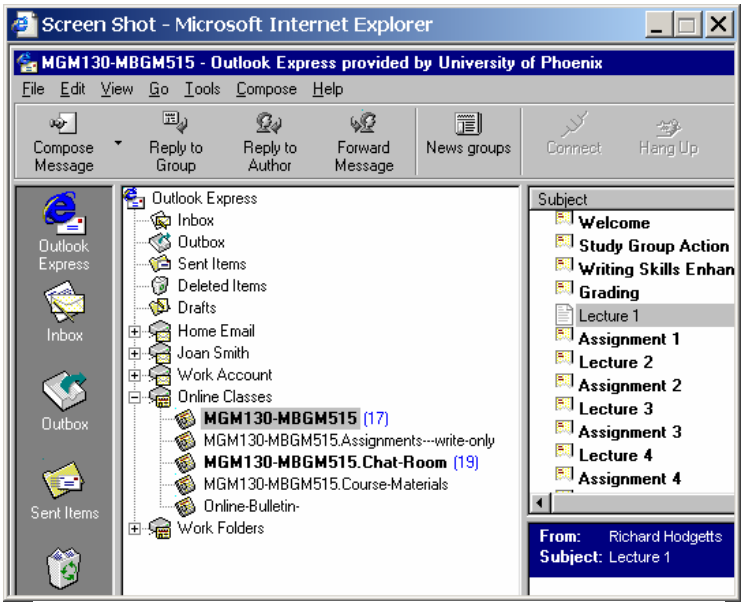

Figure 1: Phoenix University online user interface

Another example of distance learning is at MichiganTech[2] school of technology (MTU). Michigan Tech offers a Bachelor of Science in Surveying degree to distant learning students at a variety of sites, most of which are located in Michigan's Lower Peninsula. The degree is offered through the Surveying Department within the School of Technology. While the complete degree program is offered on campus, only upper division courses (3000-4000 level) are offered at a distance. Students pursuing a degree through distance learning are expected to complete lower division requirements at a local college.

Michigan Tech is currently equipped to offer courses via videotape delay and video streaming. The courses are taped as they are taught to resident students at Michigan Tech. For videotaped delay courses the tapes are mailed to sites for viewing by distance learning students. A one or two week time delay exists between classes on the Michigan Tech campus and those shown at the remote sites. This time delay is needed to prepare the videotapes for mailing and to allow mailing time. Tapes, handouts, quizzes, and exams are included with each mailing for distribution to students. Video streamed courses are available on the web an hour or two after courses are presented on campus. To gain interactivity between students and faculty, fax and email technology will be used. Videotapes remain the property of Michigan Technological University. There is, however, work towards moving to Internet delivery using streaming technologies. Tapes are viewed by students which usually contains three hours a week of lectures on a single tape. Course notes and assignments are issued by the instructor to the student. All distance-learning courses also have web pages with much of the course material available online. WebCT facilitate the access to the course web pages. WebCT is the course management tool Michigan Tech uses for distributing course information. The WebCT web page for online courses may have lecture notes, homework assignments and solutions, or an online conference or

[1] http://image73.eguard.com/universityofphoenix/17276-0/bpu.html
[2] http://www.tech.mtu.edu/distancelearn/index.html

chat area and the posting of student grades for the course. Exams are taken requires the student to come in residence as usual. The coordinator will hand out the exam and stay and collect the exams when the allotted time is up. Exams are reviewed in about two week's time. No late exams are allowed, but early exams are possible. Resources for distance learning students, including student handbook, guides, and information on MTU email.

It is unclear how Michigan Tech is delivering the labs which are required in the Surveying courses. The access to the surveying equipment and the necessary high end software are areas of concern. To be successful in providing a distance learning education in the field of surveying there is need to consider the distance learning student. Wijayratne (2003) stated that the distance learning student must be mature and self-motivated. The student must take an active role rather than the passive student who attends classes in residence. The student must ensure that he schedules his time appropriately such that he has enough time to study the course material, completing assignments, as well as communicating with the instructor on areas of the course requiring clarification. Distance learning students are at a disadvantage when it comes to questions during the time they choose to cover the course material. Questions will have to be delayed until the instructor responds, this in comparison with in residence students, questions are dealt with readily during the class. One other important requirement for distance learning students is that they should have a good high school foundation in mathematics, English, writing, and computer literate.

Another example of distance learning application is the Department of Technology and Cognition[3] at the University of North Texas. They are looking at exploring the Internet to deliver their Information Science class instructions. They make use of streaming media which makes use of Real Networks download players and plug-ins. The courses are delivered using WebCT in which various models are used to deliver courses. Some courses use only online testing, emails and chat functions while other courses use the full functionality offer by the WebCT software. The courses offered via distance learning are at the graduate level.

Another example of DL offered by another university is East Tennessee State University. The Surveying and mapping Science Department[4] is offering six of its courses online. Their DL initiative started in the spring of 2000 and currently has 20 credits in six courses available on a rotating basis, (Clark, 2004). There are two types of DL course offerings which are called Web Only (WO) and Web Enhanced (WE). The WO courses, students are given access to all of the course materials via the Blackboard DL software. This includes syllabi, lecture notes, assignments, quizzes, discussions rooms, and such like. The WE courses, students have the same access to the course materials but it is enhanced with the requirement that students also attend classroom lectures and have labs exercises at the main campus. For this reason the WE courses can be looked upon as being partial DL courses. Clark (2004) stated that there has been great success with their DL initiative; however, they have met a number of challenges which are being addressed by exploring alternatives. One of their main challenges is to facilitate the practical labs for DL students. One solution being investigated is to provide alternative DL locations for DL students but this can be very expensive. Clark (2004) stated that for a group of 15 students would require over $130,000 of hardware field equipment and at least $80,000 would be needed for a computer lab. DL locations have to be located in ideal positions where it is anticipated to service a large number of the DL students. Other alternatives are being investigated which are more cost effective.

Another example of DL offered by another university is Pennsylvania State University[5] (PSU). The Department of Geography is offering its masters degree program in GIS via DL. It is a professional degree that complements their Department's existing MSC degree offered in residence. DiBiase (2004) stated that Penn State DL initiative makes use of the ANGEL software, a commercial product created by Cyber Learning Labs[6]. ANGEL software facilitates a quiz tool, student teams, grade book, and syllabus tool, as well as to identify other changes needed to enhance the user interface that is made suitable for PSU. DiBiase (2004) stated that their course offering is exclusive of the

[3] http://www.cecs.unt.edu/index.jsp
[4] http://www.etsu.edu/geomatics/
[5] http://www.worldcampus.psu.edu/pub/index.shtml
[6] www.cyberlearninglabs.com

Surveying or Geomatics program. This requires re-consideration because GIS and Geomatics are inclusive of each other.

4.0 Distance learning technologies

Technology is developing in an everyday basis. The use of computers is growing and its growth includes a greater demand for high speed processing and accessibility to information and other resources. The use of the Internet is a well known resource that facilitates distance learning; however, prior to the Internet, distance learning was facilitated by the delivery of videos, and through the production and delivery of CDs.

One of the common technologies used in the delivery of online courses is using streaming media. The Department of Technology and Cognition at the University of North Texas explored the use of streaming media. Five categories of streaming media are identified (Cereijo, 2002):

- Streaming audio

  In this category the instructors' audio are captured and streamed to students live. Students are able to listen to the lecture in real time. Streaming media require the use of a microphone, computer with sound card and encoding software. Lectures are archived on a server which can be retrieved at a later date.

- Live streaming audio and video

  Audio and video are captured and streamed to students live. The course content is captured using a video camera and microphone, digitized, and converted to streaming media. This can be stored on a server which can be accessed at a later date.

- Archive streaming media

  This is the archiving of streaming media. This facilitates instructors with the ability to edit the content of their online course material. The archiving done here also includes the first few minutes of a course which is given at the beginning of a class for students in residence.

- Archive streaming media with graphics

  This is the archive of streaming media and its associated graphics. The Real Networks software has the ability to synchronize graphics with the audio or video stream

- Streaming audio with 3rd party software

  Third party software such as Screen Watch by Optx[7] which is a screen capture program. The software has the ability to compress the large screen capture files into files that are easily streamed over the Internet. The audio is recorded while other mouse and screen movements are synchronized to the audio track. This is very useful for software related courses.

In order to use stream media via the Internet, if done properly, will be easily accessed by students. A student can view an audio clip on the computer by clicking on the links. The specifications to run a streamed file is that only a small portion of the media file is downloaded, buffered into the student's PC RAM. When a 20 second buffer has been created, the streaming media starts playing while the rest of the stream file is buffered and read for playing "on the fly". The recommendations that students get DSL or a T1 connection for high quality, however, students having a 56.6Kb modem is the minimum specification.

[7] http://www.optx.com/

Various approaches are possible in facilitating the delivery of course materials to DL students. One approach is the use of high end equipment that capture lectures called Tegrity[8], to capture videos of the residence classes. The files created are stored as Microsoft's PowerPoint Presentation. Such files are then compressed using the Impatica[9] software which makes the files easily accessible and readily downloaded by the DL students.

5.0 Geomatics at Troy State University

There are many online systems with different models, however, in this paper the systems that are specific to the award of a Geomatics degree is the main focus. The Geomatics Profession is in transition from apprenticeship as the initial mode of entry to that of a four-year degree program in residence. In this regard, there is a need to provide educational resources to those who cannot enter a degree program in residence. TSU has a unique set of resources for those who work and study Geomatics with its emphasis on measurement science.

One of the goals of the Geomatics Program is to offer the entire program online. This is motivated by the changing nature of the Geomatics profession. There is a demand to provide Geomatics education to working professionals who cannot come to campus to participate in a residence program. Therefore, this is a unique and timely opportunity for TSU to offer its entire Geomatics Program online.

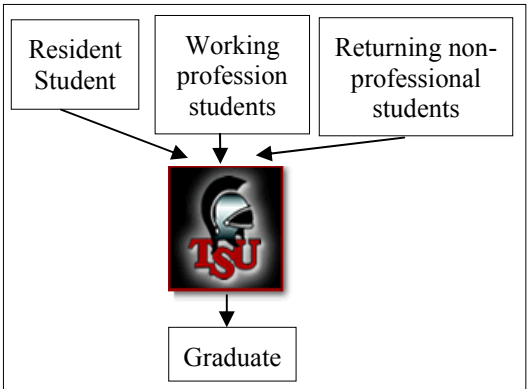

Figure 2 TSU student population

At TSU there are two types of students, residence and online as shown in Figure 2. Traditionally, the student base players are resident students. However, with the provision of the Geomatics courses it is anticipated that the student base players will be extended to include working professions, returning non-professions, and out of state students.

6.0 Generic model

The Geomatics Program at TSU has various considerations before offering the degree online via distance learning such as:

- How will the lecture courses be offered online?
- How will the labs be done, in particular, the survey instrumentations labs and the computer software labs?
- What is the best method in presenting adjunct professors' courses?

[8] http://www.tegrity.com/

[6] http://www.impatica.com/imp4ppt/

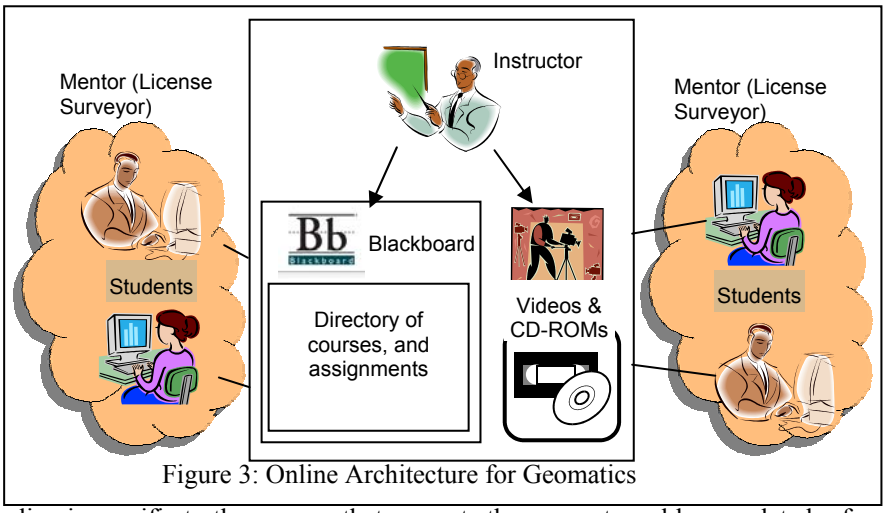

Figure 3: Online Architecture for Geomatics

To address these considerations Mason (1998)'s integrated model is adopted because is flexible enough to address these considerations. In such a model various distance learning techniques can be adopted. Figure 3 presents the architecture. The teacher virtually teaches the class that consists of students who are at a distance. The students will are taught by accessing the lectures which are online lectures and some are posted via CD-ROM and video tapes. Access to lectures online is specific to the courses that presents the concepts and has a related reference text book which the students can use as a reference. There are courses that do not have a single text book, and are typically taught through the experiences of the teacher. Theses are the courses which can video taped, stored on CD-ROMs or provided online by stream audio video.

The concept of a virtual campus requires further investigation. TSU's administrative staff is debating the possibilities of such mechanism in terms of its practicality in offering all of the university's courses, and other implementation issues associated with such a mechanism. TSU's vice-chancellor stressed that such a mechanism largely incorporates two components the implementation of the service which is termed the *facility*, with that of the people who will be responsible for the management and provision of the course, which is termed the *faculty*. These two components must be well integrated such that the quality of the end product is just as good as the quality of the same courses offered in residence. The success of such a correlation will depend upon the extent of the integration of the two components.

The main online software used in this implementation is Blackboard [10] version 5. This is one of the industry's popular teaching and learning environment; it features a robust setting for content management and sharing, online assessments, student tracking, assignment and portfolio management, and virtual collaboration. The Blackboard Learning System is well recognized for its ease of use and scalability, allowing clients to achieve widespread adoption in a supported environment. The mentors are the professional land surveyors and engineers who play a special role in the mentoring of persons entering the Geomatics profession. They provide the onsite equipment, mentoring, and computer software needed by DL students.

At TSU there are the general study courses which provide students with a broader knowledge of other common concepts, apart from their main major. The concepts are presented in a set of foundation courses which are required to complete their major. Examples of such courses are History, Calculus, Music, and such like. Some of the general studies courses can be readily implemented using distance learning, however, there are other lab courses such as Biology, Physics, Chemistry, and such like do pose a challenge because students would typically need access to a lab which contains the necessary equipment and chemicals. In addition, students will require the guidance from a competent lab technician who is capable of guiding the students to ensure that the lab work is done properly. This is a challenge and is being investigated by TSU.

The Geomatics Program at TSU has a model which is capable of addressing the shortcoming of the courses which require the access to the proper equipment and competent technical guidance. This is very important in the field of Geomatics because the lab work for most of the surveying courses such as Basics of cartography, Boundary

[10] http://www.blackboard.com/

Retracement, Advanced Measurement labs, and such like would require the student to get access to very costly equipment, and technicians who can give guidance. The model which addresses the shortcomings in distance learning for the field of Geomatics is presented in Figure 4.

The functioning of the model is dependent upon the active role played by the Alabama Society of Professional Land Surveyors (ASPLS). The ASPLS represents the core professional body that is directly affiliated to the Geomatics Program at TSU. The ASPLS has an active role in the Geomatics Program by way of donations, representation on the advisory board, student scholarships, and such like. This role is extended to include the Geomatics distance learning initiative. The registered ASPLS professionals will assist as mentors for the lab courses. This extension to the Geomatics Program model is new and has not been implemented by any of the distance learning initiatives in the Geomatics field. The lecture type classes will be implemented using Mason's (1998) integration model (IM).

The role the license surveyor in the state of Alabama includes the recognition of the Geomatics Program. Their role in our distance learning initiative is important because students typically take a year of classical survey fundamentals. Students must complete two field laboratories using traditional survey equipment including total station and automatic level. The field labs contain a number of three-hour field exercises to gain a measurement product such as a level loop or traverse. The mentors will provide access to the equipment, training on how to use the equipment, and share their experience on how to accomplish the lab objectives. Other laboratories that focus on computations will require very little input from the licensed professional, while those that focus on the use of the computer software, then some of the courses have evaluations licenses that comes with the text book (as in the case of the GIS courses) with the exception of AutoCAD. In the AutoCAD lab students will be required to collaborate with their mentor to find an organization who is willing to provide the student with access to their copy of AutoCAD. Another role of the mentor is to serve as proctors to exams and quizzes to ensure that the students take the exam and under the same exam condition as if the student is in residence.

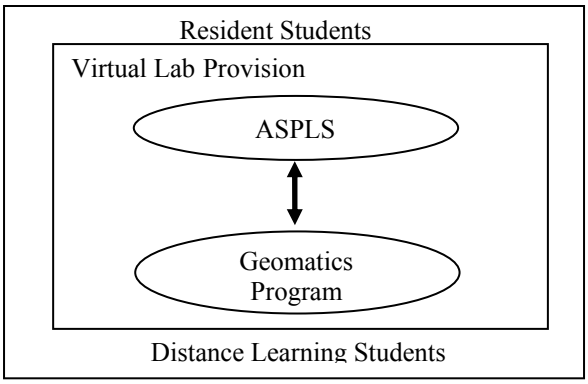

Figure 5: DL model for labs

The challenges faced by the DL initiative at TSU can be itemized as follows:

- Delivery of residence lectures to the DL students without lost of quality
- DL student access to costly surveying equipments for labs
- DL student access to costly high-end software for GIS and Photogrammetry
- Provision of exams and quizzes
- Meet accreditation standards for DL
- Suitable proctor credentials

6.0 Conclusion

The distance learning model presented in this paper is being adopted by the Geomatics Program at TSU. The integrated model is adopted with the additional component of including the services of the Geomatics professionals to assist in the practical labs courses which require access to high cost equipments, and the needed guidance from the experienced professionals. This model is the first of its kind in the field of Geomatics and is seen as a necessary

approach if the quality of TSU's graduates is to be the same between the DL and residence students. The model is the approach being adopted at Troy State University in our approach of supporting the need to bridge the gap between the Surveyors and GIS Specialists.

Other Geomatics courses which are concept driven are facilitated using DL software facilities such as Blackboard, posted CD's, and using the text books that provide students with evaluation licenses to the high end software for the period approximately one semester. Implementation of this integrated model is on-going at the Geomatics Program and is viewed as having a modular design which is capable of being developed and integrated with the DL general study courses at a future date.

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