CREATING AN AUTONOMOUS LABORATORY ENVIRONMENT UTILIZING LAPTOP SUPPORT

By

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ABSTRACT

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The advent of the laptop computer and the broadening access to wireless internet within university campuses has created a new set of possibilities for enhancing laboratory activities. The purpose of this research project is to evaluate the effectiveness or ineffectiveness of providing online educational materials for use during laboratory activities and identify any advantages or constraints associated with the delivery and utilization of said materials.

The methodology of this research began with a review of literature focusing on autonomous learning and educational curriculum content for laboratory enhancement via laptop support and the Internet. Next a series of electronic educational materials was created for laptop access via the internet

during a film processing laboratory activity. A survey was then designed to evaluate the effectiveness of student access to the educational materials and that student's ability to effectively complete the activity and autonomously function within the laboratory environment. The professor whos students participated in this study did not alter course content in any way other than notifying the students of the website provided for use during the laboratory activity. After the activity was completed students who wished to participate in the survey were directed to do so via their course website. Of the 96 students who had access to the online educational materials, 20 chose to participate in the survey.

Of those subjects who completed the survey 65% had never processed film before. Of those who had not processed film before there was a perfectly even distribution between those who were more confident or less confident with attempting the activity again without any online study aids. This research may be an indication of the effectiveness of providing these study aids via laptop support given the current technological means, operation conflictions, and restraints associated with accessing and utilizing the provided aids.

Table of Contents

List of Charts

Chapter I: Introduction

As Internet access increases in schools across America it is becoming quite apparent that the World Wide Web is one of the tools of choice for both students and educators. Research conducted by the PEW Internet and American Life project has found that 98% of American schools have some kind of Internet access for students. The study also concluded that 77% of instructional classrooms have Internet connections within them. Of the population sampled, 98% of students age 12-17 reported that they have used the Internet for school research. Thirty-four percent of the students sampled said they had downloaded some sort of study aid. A study aid can include a multitude of possible documents, presentations, multimedia displays, or programs. An important educational benefit associated with downloading study aids is that they facilitate autonomous learning for students. Students are essentially in control of what information they are exposed to. This freedom of educational choice means that students may not only view what information they want, but view it when they want and in the order they want. "It liberates the formation of learning communities from the constraints of space and time" (Duderstadt, Atkins, and Van Houweling, 2002, p.1). This allows for learning to be customized by the student in a manner that may better fit the individual. As these students choose what forms of study aids best fit them, they are able to access information that may directly fit their

learning style. As students move from a k-12 pedagogical-based educational environment to an andragogy-based form of higher education, educational autonomy should, and will, become the expectation. While educators themselves will prove to be valuable resources, it will become more important that students begin to facilitate their own learning. Research suggests that when adults take on more responsibility for their education, they also begin to critically assess the benefits of their education as a whole. As Knowles sighted in *The Making of an Adult Educator*, "Tough (1979) found that when adults undertake to learn something on their own, they will invest considerable energy in probing into the benefits they will gain from learning it and the negative consequences of not learning it" (Knowles, 1989, p. 83). Instructor's curriculum design, and access to learning aids, will be supplemental to their ability to provide quality educational opportunities and foster the development of an autonomous learning environment. Utilization of Internet access may prove to be the best means for offering a wide selection of learning materials, in multiple formats, to a diversified group of students, for a customized educational experience.

One of the cornerstones of adult educational theory is the widely recognized concept of learning styles. Indeed, learning style research and theory has existed for over forty years. Gardner's theory of multiple intelligences tells us that each person has a customized set of perceptual modalities, information processing abilities, and personality patterns (Gardner, 1983). This, of course,

means that each student has different needs and will therefore respond to educational stimuli with differing results. Some students may be perfectly comfortable learning from a text document, some may require a pictorial display or demonstrational video of the lesson, some may respond best to what they hear, while certain skills may require hands-on lab activity for a student to truly retain the concepts of the lesson. Effective use of learning styles is defined as integrated learning. "Integrated learning is an approach to curriculum, instruction, and assessment designed to help teachers and schools fuse multiple intelligences and learning styles in a meaningful and practical way" (Silver, Strong, and Perini, 2000, p. 2).

In the book *Issues in Web-based Pedogogy* (Coal, 2000) there is a model called *The Mutual Influence Model*. This model takes the opinions on education from a utopian and dystopian perspective and combines these perspectives with that of technological determinism and social determinism. The result is a methodology that finds a common ground for these perspectives in education. While the book is based on pedagogy its concepts can hold equal merit for andragogy-based education.

> Educators can use the ways in which technology can affect interaction and information processing to reshape the educational process. These changes can improve, or undermine, educational goals. The technology's characteristics are important considerations, but the applications that

> educators develop will ultimately determine whether the uses are beneficial or not. (Cole, 2000, p. 57)

The above statement can be applied to the need for proper development of Internet-based educational materials. Providing course content over the web is more than simply posting it to a site; it takes careful planning to effectively reach students in a meaningful way. This planning could be as simple as creating a web site design that flows in a logical manner allowing students to intuitively access study aids. Of course, it could also call for educators to re-evaluate the entire course content. In this study, the course content is heavily laboratory dependant, and as a result, the study aids created are customized to be used in real time while conducting the procedure at hand. On the other hand, an online educator facilitating a course that focuses primarily on conceptual or semantic data, such as an English course or mathematics, may design their curriculum in a very different manner. In either case, effective design for the procedure or lesson at hand is incredibly important. If designed effectively, any online teacher's course should help toward fostering autonomous learning amongst the students enrolled in the course.

Statement of the Problem

As innovations such as media technology and the Internet are becoming more widely incorporated into the classroom environment, a vast array of educational outlets have become commonplace in technical education. The

question educators must ask themselves is how to effectively use these technologies to enhance the classroom and laboratory environment. Laboratory activities have become a much-needed standard for technology education. While the semantic base acquired in the classroom provides the conceptual frameworks for the activity, the lab environment solidifies the procedural knowledge associated with any technical task. This study aimed to utilize streaming video technology, as well as any activity-pertinent electronic documents via the Internet, coupled directly with lab activities to allow students to access a semantic base while conducting the technical procedure at hand. The study was conducted within the University of Wisconsin Stout's photography department during the fall semester of 2004. The research subjects consisted of elementary photography students performing manual film processing in a laboratory environment along with access to streaming video tutorials and electronic documents provided via the Internet. Upon completion of the film processing activity voluntary subjects were allowed to participate in an online survey.

Research Questions

1. This section is included to address this researcher's hypotheses and objectives for this study.

2. Will there be a positive correlation between implementation of study aids via the Internet in the lab environment and students abilities to successfully gain procedural and conceptual knowledge of manual film processing?

3. Will there be a correlation between student's ability to access information in a customized manner and those students ability to perform autonomously in the laboratory environment?

4. Will implementation of multiple study aids via Internet access meet individual needs, rather than a generalized need for all?

This study aims to address laboratory-based technical curriculum while incorporating media delivery that enables students to view material that best suits their learning style. It is the intent of this research to prove the feasibility of integrated online education for most higher education institutions. Ultimately this research may help toward assessing weather or not Internet-based study aids can assist in the laboratory procedure at hand (whatever it may be) in multiple fields of study.

Significance of the Study

This study is significant to the University of Wisconsin Stout in particular due to the shifting trend toward a campus wide laptop program. While the current program is limited to mandatory undergraduate participation, it is very possible the program could be implemented for graduate studies as well in the near future. This study may be helpful toward determining both the positive and negative aspects involved in laboratory incorporation of laptop support as well as some of the technical issues any educator may encounter when utilizing such support.

Limitations of the Study

The primary limitations of the study are:

1) The study is limited to UW-Stout students who access the provided materials within eight sections of exploring photography between November 1st and December 1st 2004.
2) The survey results are limited to those students which complete the on-line survey.

Definition of Terms

As this study is technical in nature, it has a tendency to lend itself to terms that may not be common knowledge. This section is provided in an attempt to clarify the meanings of any words or phrases that may be foreign to the reader. The following definitions may vary from some sources other than the citations listed in this document. The definitions listed for this study were chosen because they provided the most concise definition for the study's purpose.

1. Andragogy – The andragogic model asserts that five issues be considered and addressed in formal learning. They include (1) letting learners know why something is important to learn, (2) showing learners how to direct themselves through information, and (3) relating the topic to the learners' experiences. In addition, (4) people will not learn until they are ready and motivated to learn. Often this (5) requires helping them overcome inhibitions, behaviors, and beliefs about learning (Conner 1996).

2. Autonomous - (a) Able to make decisions and act on them as a free and independent moral agent (Microsoft Word X, 2004). (b) Existing, reacting, or developing as an independent, self-regulating organism (Microsoft Word X 2004).
3. Ethernet - A technology that interconnects computers into a high-speed network

   originally developed by Xerox Corporation. Ethernet is widely used for LANs because it can network a wide variety of computers, it is not proprietary, and components are widely available from many commercial sources (cites.uiuc.edu 2004).
4. Pedagogy - *Pedagogy* (pèd-e-go´jê) literally means the art and science of educating children and often is used as a synonym for teaching. More accurately, pedagogy embodies *teacher-focused education* (Conner 2004 et al.,).
5. Streaming Video - Streaming video is a sequence of "moving images" that are sent in compressed form over the Internet and displayed by the viewer as they arrive. Streaming media is streaming video with sound. With streaming video or streaming media, a Web user does not have to wait to download a large file before seeing the video or hearing the sound. Instead, the media is sent in a continuous stream and is played as it arrives. The user needs a *player*, which is a special program that

> uncompresses and sends video data to the display and audio data to speakers. A player can be either an integral part of a browser or downloaded from the software maker's Web site (SearchNetworking.com, 2004).

The next chapter in this research will be a comprehensive review of literature related to the subject areas involved in this study. Most of the material reviewed for this study can be found in the University of Wisconsin Stout Library Archives or on the World Wide Web.

Chapter II: Literature Review

This section will summarize literature reviewed by the researcher and provide detail on the following subject areas:

1. Autonomous learning.
2. Curriculum content for laboratory enhancement via laptop support and the Internet.

Autonomous Learning and the Transfer from Pedagogy to Andragogy

While the implementation of laptop computers in the lab environment may be a means for education discussed in this thesis, the most important outcome of this implementation would be the fostering of autonomous learning in an andragogical environment. While laptop computers may be fairly new inventions when considering the history of higher education, the concept of autonomy and andragogy is not.

Knowles (1973) published a book titled *The Adult Learner: A Neglected Species*, which utilized the concept of andragogy that has become widely accepted in higher education. Knowles believed that adult education should become an environment of self-direction and learner-centered activity that incorporates the learner's life experiences with available learning resources. While Knowles may have published the first definition of andragogy, that has been since expanded upon, it is important to remember that studies on andragogy and autonomous

learning have been going on for decades, if not centuries. John Dewey had been experimenting with similar learner-based educational practices in pedagogy as early as 1896. Dewey's studies were focused primarily on children, but he did believe that activity-centered learning was much more advantageous to student's personal growth than traditional authoritarian dictation. In 1926 the American Association for Adult Education began to see a need for reform of adult learning and began researching the subject. Influenced by Dewey, Eduard C. Lindeman wrote in *The Meaning of Adult Education*:

> "Our academic system has grown in reverse order. Subjects and teachers constitute the starting point, [learners] are secondary. In conventional education the [learner] is required to adjust himself to an established curriculum....Too much of learning consists of vicarious substitution of someone else's experience and knowledge. Psychology teaches us that we learn what we do....Experience isthe adult learner's living textbook" (Cited in Conner, 1996, p.19).

Given the level of independence expected from students in an educational system based on andragogy, the Internet must be viewed as the one of the most promising outlets for true peer-to-peer interaction and exchange of experiences. "It is both an interactive and personal medium" (Weller, 2002, p. 13). This important distinction puts the Internet ahead of many media technologies in respect to educational value. Television, for example, is quite simply a one-way

communication device. "Using the net is an active one, and more significantly it is two-way: the user interacts with other users" (Weller, 2002, p. 13). "Collaborative learning processes help students to achieve deeper levels of knowledge generation through the creation of shared goals, shared exploration, and a shared process of meaning-making" (Palloff, Pratt, 2001, p. 32). Discussion forums, chat rooms and web boards are proving to be a great way to involve students in meaningful discussions without some of the hindrances that the traditional classroom may pose. For example, consider the case of the introvert and extrovert. In a classroom environment, if not any environment, extroverts most commonly dominate the conversation. Students with more introverted personalities may not always feel as comfortable speaking in a situation when they are overpowered by extroverted people asserting their opinions. While this may be the case in the classroom, these same students may prove to be quite extroverted in a web-based discussion forum. The opposite may also prove to be true. Some students that may be extremely extroverted in the classroom, even to the point of abruptly giving feedback to the group before thinking through their thoughts fully, may find themselves considering their own thoughts more critically than in the traditional classroom environment. As Palloff and Pratt stated in *Lessons From the Cyberspace Classroom*:

> "In our experience, computer-mediated distance education can successfully draw out a student who would not be considered a noisy

> learner in traditional. It can provide an educational experience that helps to motivate students who appear unmotivated in another setting, because they are quieter than their peers and less likely to enter a discussion in the classroom. We are also discovering, however, that interactive skills learned in the online environment can be carried over to the face-to-face setting" (Palloff, Pratt, 2001, p. 110).

For those who question the social limitations of online education the previous quotation is definitely a positive observation.

The other clear advantage toward autonomous learning that the Internet seems to have over the traditional classroom is that students may leave each other feedback on discussion boards and therefore they need not meet at the same time. This is particularly advantageous to distance education students who may not find it financially feasible to make long trips to a far off university. Of course, the key concept is that students can access information when they choose. The discussion board postings can always be reviewed and feedback can be left accordingly. Even when a class is conducted in the traditional setting, use of Internet-based discussion groups can be beneficial in that there is a recorded dialogue of the interaction between students. Students and teachers alike can then save these dialogues to disk for future use, possibly as a study aid.

Curriculum Content for Laboratory Enhancement Via Laptop Support and the Internet

Traditional classroom teaching tools such as text documents, pictures, videos or filmstrips, visual presentations, audiocassettes, and interactive learning tools such as computer games can all be great means for reaching a variety of students. Utilization of the Internet can now make all of these forms of educational materials, many previously dependant on varying technologies, available to students and the public via the personal computer. The Internet provides a level of accessibility that has never been paralleled. Providing educational tools and study aids via the Internet could allow students to access needed materials or learning aids when they need them. For example, a semantic base provided on a student's laptop during the activity could directly back up laboratory-based work. Many college campuses around the country are becoming wired with Ethernet connections and air port access throughout campus from classrooms, to labs, to students housing, etc. The growing availability of high-speed Internet connections to the public has also expanded student access to information hundreds or even thousands of miles from the institution which they attend. While each of these respective institutions may have the facilities necessary for lab work in a given field the course instructor may only need to be found at one location (Rose, 2002). Proper course materials provided via the

Internet can allow students to function autonomously in their respective lab environments. If designed correctly, web sites could be created to allow students access to activity-pertinent electronic documents for direct consultation in their laboratories.

When choosing content for Internet-based learning aids we must keep in mind that each learner is unique, and therefore has an individual set of learning characteristics. "It's inappropriate to assume all learners have similar learning styles and can be force fitted to one delivery style" (Conner, 1996, p.11). Educators must therefore make an effort to provide a variety of learning aids to reach a variety of students.

"In the classroom, each medium poses barriers for some students, while offering particular opportunities to others. None works optimally for every student or for every situation, which means that several media options should be available." (Rose, 2002, p.63)

Providing a range of learning materials to students is not really a matter of what to provide, but how to provide the material electronically. "First it is important to recognize that even for Internet-based courses, older, low-tech forms of technology are not necessarily displaced" (Cole, Ed; 2000, p.59). Traditional learning aids such as graphs, charts, articles, texts, pictures, videos, etc. can all be incorporated into instruction via the Internet. Many files, such as word processing or spreadsheet documents, may already prove fit for posting to the Internet as they

are already digitized. Physical documents such as photos and copied handouts may need to be scanned and digitized for posting on the web. Most higher education facilities are equipped with a technical support staff that is available to perform these services for educators. Most often, this staff can also assist in transferring videos to compressed format for the web. As technology becomes increasingly incorporated into educational systems, a greater need for technical staff and teachers with a background in technology will be seen. Educators who take an active role in incorporating and understanding digital and Internet-based technologies in their classroom will have a clear advantage as the educational system as a whole moves into the future.

The next section in this research paper will describe the methodology behind this study. The section is included to provide information on the subject population and sample selection as well as the instrumentation, data collection procedures, data analysis and limitations of the study.

Chapter III: Methodology

Introduction

This chapter will describe the following aspects of this study:

1. The selection of the population used in this study,
2. The instrument used to collect data for this study, and
3. The procedure used to conduct this study.

Research Design

Much of the work associated with this study was in the creation of electronic educational materials to be used during the film processing activity prior to the subject survey. The subjects were allowed access to a website providing the educational study aids to be used during the film processing activity. The materials consisted of a film processing video customized for the specific laboratory in which the subjects would be conducting the activity, a pictorial flowchart in Adobe Portable Document Format (PDF) displaying the steps associated with the activity, and a text document with step-by-step directions for completing the activity. The study aids were created and implemented into the website by the researcher. This took a considerable effort and comprised a bulk of the research. The goal was to provide a combination of study aids, that when used together would enhance the educational experience and aid toward the individuals ability to customize his or her education. The PDF

document was meant to appeal to those who prefer written, concise directions. The pictorial flowchart was meant to give a sequential, visual representation of the activity with basic text directions included. The video was created with the intent to convey a multitude of sensory data in an interesting format.

A clear understanding of the film processing activity was the prerequisite to creating these study aids, but the video required a special amount of attention. The creation itself was a large project. The process began by scripting out a narration based on the original instructions for processing film in the University of Wisconsin Stout labs. The video was created exclusively for Exploring Photography students and therefore some elements of the subject matter, such as the film speed and brand, were customized specifically for the students of these courses. After scripting the narration, the activity was drawn up in storyboards to prepare for shooting. The final footage was then edited together, cut with transitions, compiled with the narrative audio and music, and eventually titled to clarify steps of the process. The video comprised nearly 150 hours of the total research. Once it was complete and coupled with the other online study aids, the materials were ready for incorporation into the classes being utilized as the population for this study.

Each of the online study aids was designed to meet certain human perceptual modalities. The goal of providing a multi-sensory array of materials was to provide subjects with the opportunity to view customized materials

depending on his or her perceptual preferences. It was also a goal that the choice of educational material would allow for the subjects to learn and perform autonomously within that environment. Another goal of this research is to expose any technical issues that need to be addressed before fully integrating educational materials into a laboratory activities online content.

Population

Sample selection for this study was limited to all students participating in an Elementary Photography course for the fall semester of 2004 at the University of Wisconsin Stout. Eight sections of elementary photography students participated in this study. These sections consisted of population of 96 total students. The sections were given the traditional course treatment and additionally allowed access to the laptop study aid website created for this study. The samples from this population were voluntary and completely anonymous.

Instrumentation

All students were given a follow-up survey after completing the film processing activity. The survey asked questions pertaining to the effectiveness of additional laptop access to information when in the laboratory environment. Some questions asked for nominal data or the subject's thoughts or opinions while other questions allowed subjects to select answers from a five point Likert scale with the following choices or equivalent: 1. strongly disadvantageous, 2. disadvantageous, 3. neutral, 4. advantageous, 5. strongly advantageous. In order

to assure validity of the instrument the survey was constructed resembling current professional literature pertaining to technology education. The instrument itself can be viewed in appendix A.

Data Collection and analysis

The data from the on-line survey was collected over a two month period from October 1st and December 1st 2004. The survey respondents were voluntary and anonymous. The data was obtained from a Desire 2 Learn ™ course survey. Desire 2 Learn was the software used for online access to course materials by the subjects in the surveyed population. The data from this survey was collected and tabulated by the University of Wisconsin Stout Data Analysis department. Frequencies and percentages were calculated for items 1-3, 4(A-C), and 5. Frequencies, percentages, mean, and standard deviation were calculated for items 6-8.

The next chapter in this research paper will display the results of the *Evaluation of Online Study Aids* survey displayed in appendix A. The data was compiled and evaluated by the University of Wisconsin Stout Statistical Analysis Department in December of 2004.

Chapter IV : Results

Introduction

This study was conducted with the purpose of evaluating the effectiveness of utilizing laptop support to enhance laboratory activities and aid in fostering autonomy in the subject. The survey was voluntarily completed by 19 of the 96 students in the exploring photography sections involved in this research, yielding approximately a 20% response rate. The instrument was designed to assess the subjects prior knowledge of the activity, determine which online study aids were accessed by the subjects, evaluate the effectiveness of the online materials and the format in which they were provided, and determine the subjects likes and dislikes pertaining to the use of the online materials.

Findings

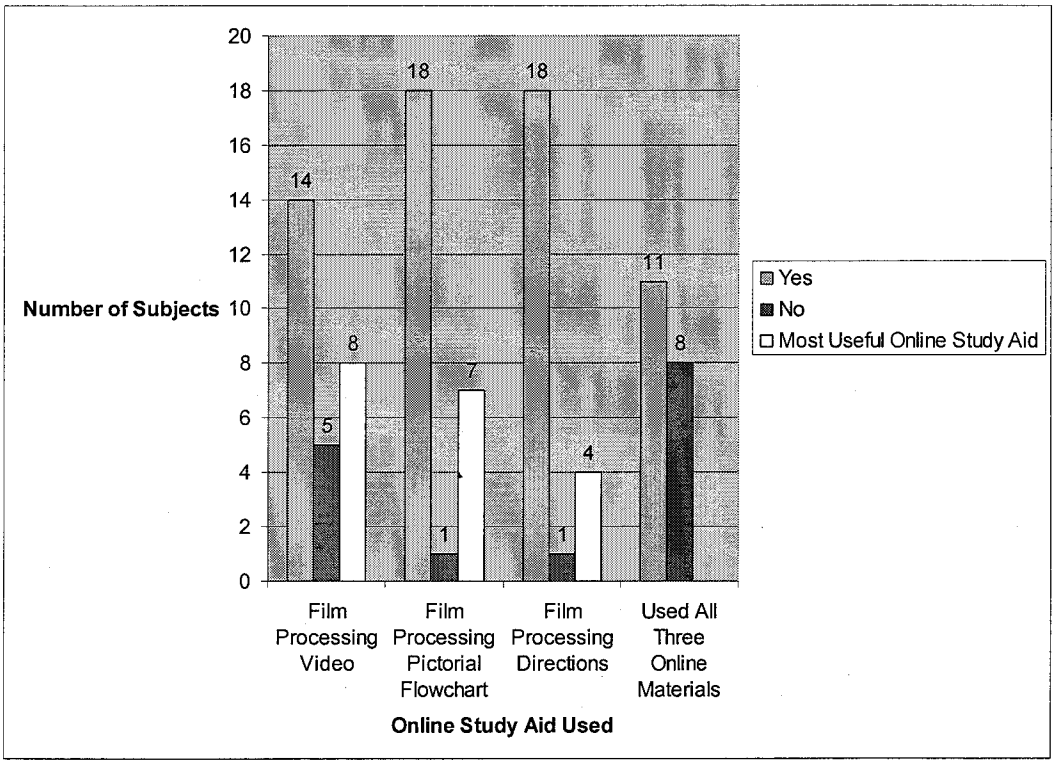
The following charts and accompanying discussion was gathered from the survey questions utilized in this study. A summery of findings concludes this section.

The first question addressed the academic status of the subjects participating. The subjects who responded to the survey consisted of approximately 21% freshmen, 47% juniors, and 32% seniors.

The second survey question addressed the population's previous exposure to the activity. Of the subjects who responded to the survey, 65% had never processed film before completing the activity utilizing online support.

The third question identified weather the subject accessed the online materials at all. Only one subject indicated that the online materials were not accessed and that subjects survey results were subsequently excluded from the statistical evaluation.

Chart1: Subject Study Aid Usage and Preference

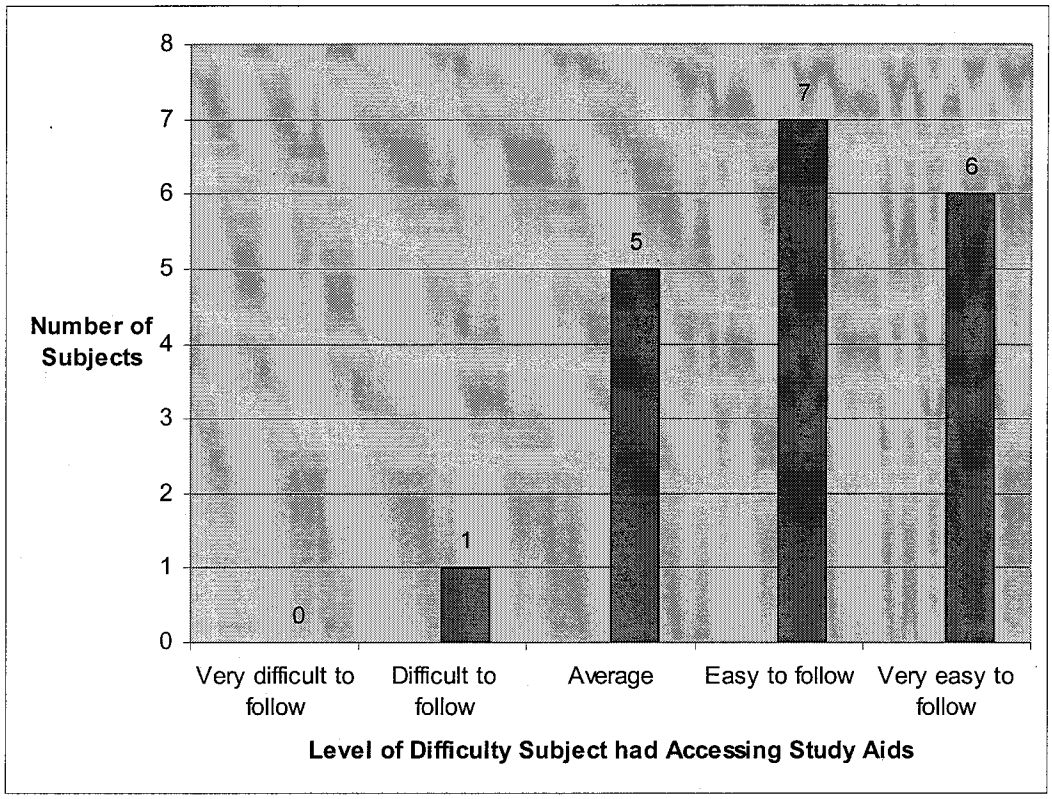


Questions four and five determined which online materials were accessed the most individually as well as collectively and which materials the subjects

involved in the research ultimately found the most useful. Chart number one displays the statistics associated with each online materials individual usage, the percentage of subjects who utilized all three materials, and the subject's opinions on which material they found the most useful. Of the subjects who responded to the survey approximately 74% reported individually utilizing the streaming video, approximately 95% reported individually utilizing the pictorial flowchart, approximately 95% reported individually utilizing the pictorial flowchart, and approximately 58% reported utilizing all three of the online study aids. Overall, 40% of the subjects found the video the most useful, 35% found the pictorial flowchart the most useful and 20% found the written directions the most useful.

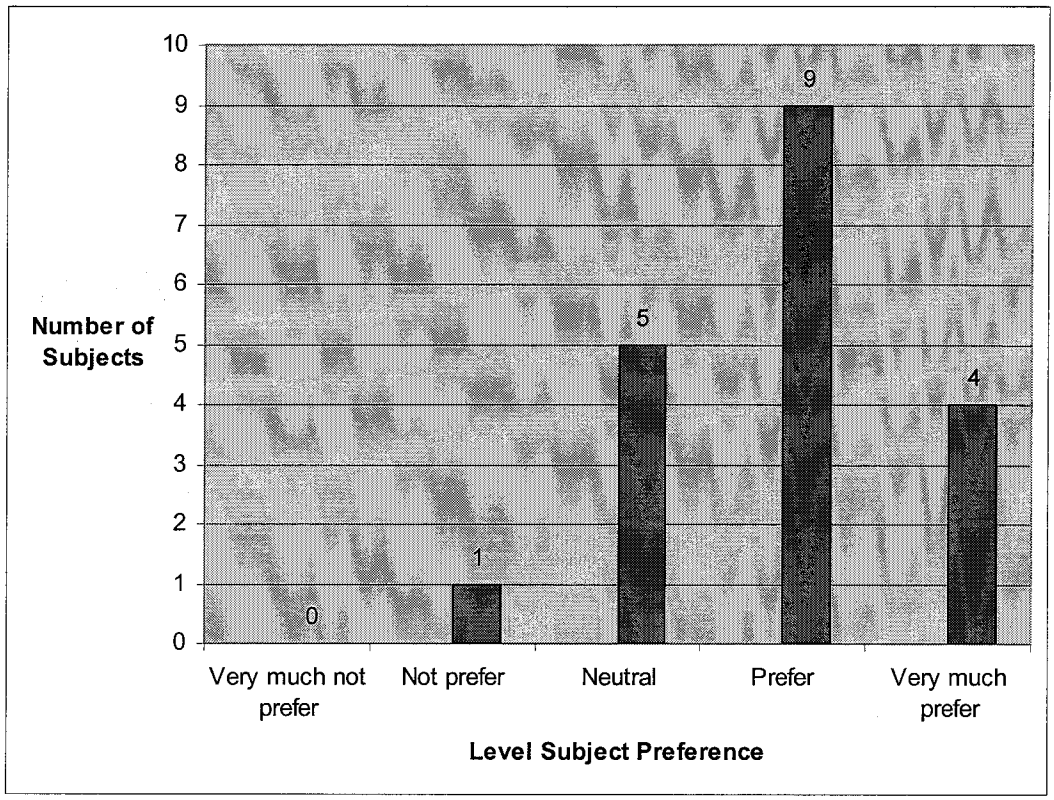
Question six addressed the format in which the online material was provided. 95% of the subjects found the format in which the online study aids were provided to be average to very easy to follow. Individual response levels can be viewed in chart two.

Chart 2: Subject Opinion of Format in Which Online Study Aids Were Provided



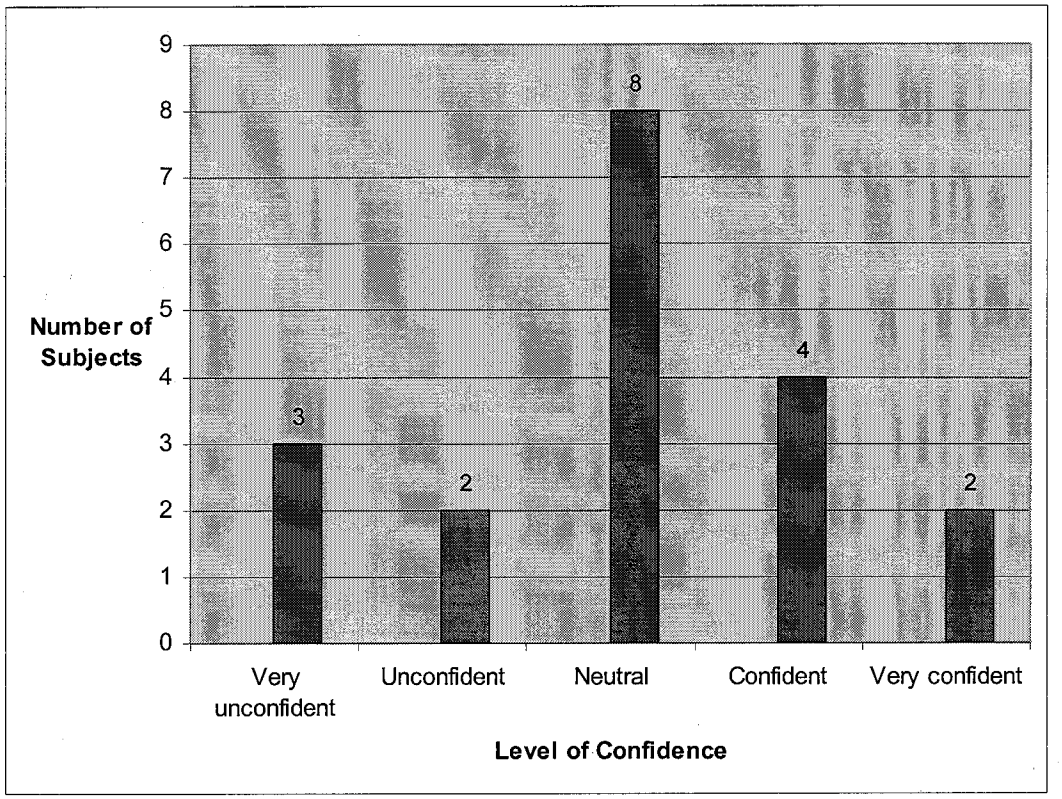
Question seven addressed the subject's preference for other laboratory activities to be supplemented with online material. 90% of the subjects who responded to the survey had a neutral to very high preference that future laboratory activities be supplemented with online study aids. The individual quantities of preference are displayed in chart number three.

Chart 3: Level of Preference That Future Laboratory Activities Include Online Study Aids



Question eight addressed the subject's level of confidence toward performing the activity again without online study aids of any sort. 30% of the subject's responses indicated that they were confident to very confident with the idea of conducting the activity again without the online study aids, while 25% of

Chart 4: Subject Confidence in Performing Activity Again Without Online Study Aids



Questions nine through eleven asked for the subject's likes and dislikes in respect to the activity and the associated online study aids as well as any suggestions for online materials that were not included on the activity website.

A table displaying the data, both quantitative and qualitative, can be found in appendix B of this paper.

The next chapter in this research paper will clarify any limitation to thee study as well as give this researchers conclusion and recommendation for future studies.

Chapter V: Limitations, Conclusions, and Recommendations

This study was conducted with the purpose of evaluating the effectiveness of utilizing laptop support to enhance laboratory activities and aid in fostering autonomy in the subject. This chapter will summarize the limitations associated with this study, provide conclusions based on the results of the online survey, and give recommendations for use of this research or possible future research on this subject.

Limitations

As much of this study was heavily dependant on technology and student computer resources those were the areas of the study most susceptible to weaknesses. This was particularly evident with the streaming video study aid. The department server used for streaming the video to the research subjects was limited to the QuickTime ™ streaming video encoding. This resulted in software compatibility issues for many students. The final outcome was that many subjects could not access, or had great difficulty in accessing the video.

Another limitation to this study was the amount of time in which students had to complete the survey. In order to obtain the data in time for use in this research paper the subjects were limited to two months to complete the survey. It is possible that a greater percentage of the initial population could have

participated in the study had there been more time for them to complete the survey.

Conclusions

The following conclusions are based on analysis of the surveys completed during this research.

Conclusion 1: Based on the results of the data it is reasonable to conclude that providing multiple forms of study aids gave the subjects the opportunity to autonomously customize the activity. There were significant numbers of subjects that preferred each of the three study aids provided. Although, it was quite surprising that the highest number of subjects, 40%, preferred the streaming video over the other two aids despite the fact that 30% of subjects did not, or could not, access the video. Perhaps this is due to the nature of video. Video is both auditory and visual in nature and the addition of titles provides for an instructional component that could arguably substitute for a written direction sheet. Of course the results from question seven were also promising. Only 5% of the subjects who responded to the survey stated that they would not prefer future laboratory activities to supplemented with online study aids. The overwhelming majority of subjects were open to the idea of incorporating the kind of study aids used in this research in future laboratory activities. Although there was a positive trend in the subject's responses toward incorporating study aids into future lab work, the results of question eight were not as promising toward the idea of fostering

autonomy in the lab environment. In fact, there was nearly a balanced distribution between those who felt confident in performing the activity again without any study aids and those who did not feel confident with the idea. Given the amount of neutral subjects it is this researcher's conclusion that confidence would most likely increase with repeated performance of the activity.

Conclusion 2: Based on the results of question six, it is apparent that a simple format for the delivery of online study aids is acceptable by most subjects in the study. In fact, only 5% of the subjects found any more difficult to follow than an average website. The website created for this research was very simple with the links to the study aids marked clearly. The statistical results seemed to lean toward approval of the simplistic format.

Conclusion 3: After reviewing the data and responses from the survey and completing the literature review, it is apparent that technical support personal are critical to assuring the functionality of study aids provided online. Although some issues, such as the type of streaming server available, may be out of the teacher's control, technical support personal would be valuable in creating functional online assistance. Educators are primarily focused on teaching the lessons at hand. This study highlights the importance of educators becoming increasingly more technologically literate, but the kind of learning researched in this study is really in it' infancy and it will be some time before online study aids are working as effectively as they could.

Recommendations

Recommendation 1: The technical issues that hindered this research will continue to arise when providing online study aids to students. This is due to the variety of computer systems available today and the subsequent multitude of content viewing programs available today. The verbal feedback from the subjects who completed the survey shows that this is particularly an issue when streaming video. While many students had viewer programs that supported the QuickTime ™ streaming format, many others didn't. Even some students who had Macintosh ™ computers, which natively support QuickTime™, still encountered problems accessing the video. It is this researcher's recommendation that any teachers contemplating this kind of online study aid integration work with students to ensure that all students have a viewer program for every type of online study aid utilized in the course. The viewers used must be updated to conform to the encoding and versions of the materials. For example, if an educator is using the latest version of QuickTime ™ to encode and serve a video, the students must all have the latest player. Controlling the format and playback capabilities of the materials and the students accompanying players will prove to be one of the biggest challenges educators will encounter.

Recommendation 2: One very positive trend was the subject's approval of the website format utilized to access the study aids. The website was intentionally kept simplistic in nature to direct the viewer to the material with little distraction.

It is this researcher's recommendation that any educator considering implementing online study aids keep the web interface to the materials as simple as possible. Spend more time making sure the peripherals involved in such a venture, such as compatible viewing software, are available and distributed to students or that students are directed to a source.

Recommendation 4: This recommendation also addresses technical issues associated with providing online study aids. In order to provide an effective and reliable online educational experience, teachers, administrators and students alike will need to be consciously aware of the current constraints involved with accessing varying types of online materials. Technical support personal will be increasingly important in this effort. Administration must focus on making sure the funds are available to support such efforts. For example, multiple streaming servers designed to support all formats may be necessary to meet many students compatibility needs. Perhaps one day computing resources, players or viewers will become more universal and standardized. Until that point it will take a conscience effort by all members of the academic community to be aware of compatibility issues while working within their means to provide the best solutions possible.

Recommendation 5: This recommendation is included to suggest possible future research in this field of study. The possibilities the Internet and wireless technologies have brought to the educational systems of the world are literally

endless. The technologies utilized in this research are effective, but the reality of the situation is that this kind of technology is really in its infancy. The problems were encountered in this study, such as the viewer and file compatibility issues, will most likely be less of an issue as the technologies utilized by educators, and the public and private sectors alike, continue to evolve. A study into the changing technologies and the future implications of these technologies on the educational system would be a worthy effort. Given the nature of change associated with these technologies, no amount of study should be considered repetitive. The fact is the technology is constantly changing and so will it's means of use and implementation into education. Research conducted to determine the most effective means of reaching students with streaming video could be a study in itself. Creating a video is a huge amount of work to begin with. Implementing that video in best possible way to meet not only the support needed for Internet use, but the supports needed on student computers would be equally as challenging of a task. This kind of research is what will eventually lead to a standardized system that will lessen some of the issues with compatibility experienced during this study. It is this researchers hope that there will be a day where electronic material encoding and viewing will not be an issue at all. If research is continued and software developers are integrated into the process with the end goal of making electronic data universally accessible, there will be a day when nearly every form of information and media on the planet can be accessed with ease. The

educational benefits of such a system, both to individuals and societies, will be unlike any that has human kind has ever experienced. The effects of such a system are and will change the way we learn dramatically. Even in its infancy, the Internet and the available technologies associated with it have already had an astounding effect on the educational systems of the world, as well as cultures and societies. The possibilities for the future are endless..

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Appendices

Appendix A: Online Survey

ON-LINE SURVEY

Thank you for taking the time to participate in this survey. Your results may help to improve future educational experiences. By completing this survey you are expressing your consent to participate in this research. You are not required to participate in this research. There are no foreseeable risks related to your participation in this survey. Your responses will be completely confidential and will be summarized as part of this research. Any questions or concerns can be addressed by contacting the researcher or research advisor as follows. Researcher, Keif Thomas Oss, 715-529-6063, ossk@uwstout.edu. Research advisor, Dr. Steven Schlough, 715-232-1484, schloughs@uwstout.edu. Research Administrator, Sue Foxwell, 715-232-1152, foxwells@uwstout.edu. Thank you very much for participating in this study, Keif Thomas Oss Candidate for Masters in Career Technical Education.

1. What is your status as a student at UW-Stout?
   - o Freshman.
   - o Sophomore.
   - o Junior.
   - o Senior.
   - o Graduate Student.

2. Have you ever processed film before taking this course?
   - o Yes.
   - o No.

3. Did you access the online materials provided for the lab activity?
   - o Yes.
   - o No.

4. Which of the online materials did you access?
   - o Film Processing video.
   - o Film processing pictorial flowchart.
   - o Film processing directions.
   - o None.

5. Which online material did you find the most useful?
   - o Film Processing video.

- Film processing pictorial flowchart.
- Film processing directions.

6. The format in which the online materials were provided was_____.

- Very easy to follow.
- Easy to follow.
- Average.
- Difficult to follow.
- Very Difficult to follow.

7. You would _____ prefer that other lab-based activities have on-line materials provided.

- Very much prefer.
- Prefer.
- Neutral.
- Not prefer.
- Very much not prefer.

8. After viewing the on-line materials and conducting the film processing activity, you feel _____ in your ability to complete the activity again without aids of any sort.

- Very confident.
- Confident.
- Neutral.
- Unconfident.
- Very unconfident.

9. What did you like best about the on-line materials provided?

10. What did you like least about the on-line materials provided?

11. Are there any online materials that may have aided you in the lab activity that were not included (please list materials)?

Appendix B: Survey Results

Question	Possible Responses	Frequency of Responses	Percentage of Responses
1. What is your status as a student at UW-Stout?			
	Freshmen	4	20%
	Sophomore		
	Junior	10	50%
	Senior	6	30%
2. Have you ever processed film before taking this course?			
	Yes	7	35%
	No	13	65%
3. Did you access the online materials provided for the lab activity?			
	Yes	19	95%
	No	1	5%
4. Which of the online materials did you access?			
	Film processing video	14	70%
	Film processing pictorial flowchart	18	90%
	Film processing directions	18	90%
5. Which online material did you find the most useful?			

	Film processing video	8	40%
	Film processing pictorial flowchart	7	35%
	Film processing directions	4	20%
6. The format in which the online materials were provided was_____.			
	Very easy to follow	6	30%
	Easy to follow	7	35%
	Average	5	25%
	Difficult to follow	1	5%
	Very Difficult to follow	0	0%
7. You would _____ prefer that other lab-based activities have on-line materials provided.			
	Very much prefer	4	20%
	Prefer	9	45%
	Neutral	5	25%
	Not prefer	1	5%
	Very much not prefer	0	0%
8. After viewing the on-line materials and conducting the film processing activity, you feel _____ in your ability to			

complete the activity again without aids of any sort?			
	Very Confident	2	10%
	Confident	4	20%
	Neutral	8	40%
	Unconfident	2	10%
	Very unconfident	3	15%

9. What did you like best about the on-line materials provided?	
	Video and pictures with directions. I am a very visual learner. It was very helpful.
	It gave me the directions. Video did not work on either my PC or Mac.
	Pictures with flow chart.
	The pictures.
	Convenient, easy to understand.
	Visual and written aids.
	Very Informative.
	The chart showed step by step directions with visual aid.
	They were very helpful and will be easy to access if I would need any help.
	They were step by step.
	The video was nice to watch because you could see the process actually being done.
	That we could print off the directions.
	It was easy to understand.
	The movie.

10. What did you like least about the on-line materials provided?	
	The video had issues downloading the first time.
	Nothing.
	Video did not work on either my systems. The PDF with pictures was not that interesting. Doing it in class was most helpful I think.
	They were on-line and not handed out.
	Was inconvenient to off campus students, especially non-mac users.
	There were no times for developing the types of film.
	I was not able to access the video until I came into the lab. I couldn't download it on my computer at home. Also the other computers around campus do not have sound which is need for this video.
	Have it be more structured to follow along.
	The video didn't have any sound.
	The video was very slow, I liked the other two better.
	The video had a lot of numbers in it and that should be saved for the handouts. Make the video more for getting to know the process and steps and why we take certain steps verses how long everything happens for (chances are the times will be different per person/film anyway so just focus on the process).
	I couldn't view the video, it wouldn't download.
	The video went way too fast, i hardly had time to write down the info.
11. Are there any online materials that may have aided you in the lab activity that were not included (please list materials)?	

	Not really.
	Put measuring amounts on the sheet with pictures. This would make this sheet more useful than the written directions.
	No.
	Times for types of films in developer.
	No.
	No.
	The video makes a nice visual and i think that this, with the handouts and demo will make a very detailed explaination of the steps to film developing.
	The video makes a nice visual and i think that this, with the handouts and demo will make a very detailed explaination of the steps to film developing.