Introduction to the Guided Distance Learning Model

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Abstract

The Guided Distance Learning Model presents a distance education course in a style resembling that of a traditional teacher-student discourse. Interaction between students and the instructor is facilitated through electronic mail, a course newsgroup and a chat room. Course material presented via the Mallard Asynchronous Learning Environment, is not designed to replace, but rather to supplement the course textbook just as an instructor might do with lectures in a traditional classroom setting. Graphs and figures from the textbook are clarified using additional text and graphics plus streaming audio. Real-world examples of the material are made available through streaming audio and video, as well as links to relevant web sites and biomedical companies. On-line quizzes allow both the instructor and students to assess comprehension and recognize problem areas. The students’ feedback is immediate, tailored to their response to each question. Students are actively involved in the learning process while being guided through the course material on a deliberate path set by the instructor. Students are able to proceed at their own pace and re-examine difficult material. The Guided Distance Learning Model was recently tested in a Medical Instrumentation course with a group of on-campus students at The University of Illinois at Urbana-Champaign. Most students (70%) cited technical difficulties as the main problem with the use of the Guided Distance Learning Model. Survey results indicated that adequate interaction took place between the students and the instructor. In addition, the majority of the students surveyed (88%) agreed that the Mallard supplement helped them learn the course material.

Background

Although there is arguably no substitute for an effective in-class lecture, it is not always feasible for students to attend courses at the hours they are scheduled. Distance learning provides an alternative to in-class lecture by accommodating students both on and off campus. Non-traditional students typically have specialized research interests or are located in remote areas. In addition, corporate professionals and employees committed to lifelong learning need access to education that is not constrained by location or time. In the past this type of education took the form of correspondence courses, videotapes and textbooks with very little interaction between the students and their educator. More sophisticated forms of distance education utilize television and computer interfaces for two-way audio and video instruction. Research in this area has shown that a well-planned distance education course could provide students with an education comparable to that of on-site instruction.
In recent years, the World Wide Web has presented an unprecedented opportunity to disseminate information in various formats to people all over the world. Some researchers have investigated the claim that the World Wide Web can liberate teaching and learning from the time restraints of course schedules and the physical limitations of the classroom. They propose that the contribution of the Web must be evaluated in terms of its impact on improved accessibility and improved learning at a reduced cost. Wallace and Mutooni developed a flexible Web-lecture structure and compared its effect on student performance to a typical classroom style lecture. In their study the students were free to choose either text-with-images or video format. Wallace and Mutooni argued that different media play a crucial role in the absorption of lecture materials. In light of these findings, the multimedia capabilities of the World Wide Web may address concerns associated with instructional delivery versus student learning styles.

Technological advances have continued to pave the way for interactive distance education through Web-based on-line courses, and in particular, Asynchronous Learning Networks (ALNs). Asynchronous Learning Networks via the World Wide Web provide a level of interactivity previously lacking in distance education courses. Kashy et al. studied the use of technology to enhance student learning and performance in large classes. They found that ALN technology could successfully facilitate the learning of difficult material by implementing techniques of effective education, such as providing students with immediate feedback and giving them the opportunity to correct their own mistakes.

There are many forms of interactive courseware, such as WebCT, CyberProf and Mallard that can be incorporated into the design of an ALN. Graham and Trick showed Mallard to be an effective Asynchronous Learning Environment as a supplement to regular lecture. Their research focused the introduction of Java applets into Mallard, enabling the instructor to pose a more comprehensive set of questions that allow for graphically based responses.

Some research is concerned with evaluating the cost and accessibility of Web-based instruction. Others are studying ways in which Web-based instruction can supplement or replace traditional on-campus learning. These issues must be addressed as the use of the Web in the educational realm increases. The ability to help improve learning, however, is not necessarily a function of the technology used but of the instructional design of the educational medium. Although we realize there are many emerging techniques, our focus is on instructional design. Our goal is to merge common Web-based interactive and instructional software and techniques to optimize the design of distance education courses. We will introduce the Guided Distance Learning Model (GDLM) and present the results of its implementation in a junior/senior level electrical engineering course.

Purpose

Distance education has grown out of the need to extend educational opportunities to non-traditional students. One example of distance learning has class notes and other materials available on-line. A computer screen replaces a professor’s blackboard so students in many locations can access identical lecture information at their convenience. Some professors have opted for two-way video conferencing that allows remote students to interact with the professor while he or she is lecturing in the classroom. Our model combines certain aspects of these

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* A general review of Asynchronous Learning Networks is found in an article by Beth Panitz entitled “Learning on Demand.”
approaches to on-line Web-based education and adds features designed to facilitate student comprehension of the course material.

Valid concerns have been raised about the legitimacy of Web-based education. Some researchers feel that ALNs tend to threaten the sacred institution of the classroom. David Jaffee notes that ALNs pose a potential threat to the teacher-centered classroom model by replacing the physical experience with a virtual environment. “The receptivity and perceived legitimacy of new educational delivery modes is strongly related to the extent to which these instructional technologies reinforce or retain the central elements of the…[traditional] classroom setting.” The GDLM attempts to capture the essential elements or techniques used in the traditional classroom setting by supplementing the course textbook just as an instructor might do in a lecture. In the GDLM, students are guided through the course material in a particular sequence just as they would be in a traditional course. Although, in many respects, the personal interaction that transpires in a classroom can not be duplicated in a virtual environment, the GDLM is presented as an effective alternative for students who would otherwise have no access to higher education.

The Guided Distance Learning Model

The Mallard Asynchronous Learning Environment was chosen as the basis for the GDLM. Mallard is a Web-based interactive learning environment developed in the Department of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign (UIUC). Mallard’s unique format and accessibility to us at UIUC made Mallard an obvious choice for use with the GDLM. The Mallard environment is password-protected, ensuring a secure environment for course development. Students have access to the Course Information and Syllabus, Announcements, Lessons, Grades, and Newsgroup within their individual Mallard home page. Course material, images, and multimedia files can be created externally and uploaded directly into Mallard. Mallard also provides for the automatic grading of quizzes and immediate feedback for the student. These features facilitate the merging of effective Web-based instructional techniques into the GDLM.

In a traditional setting, the instructor expects students to read material before they come to class, with lecture time normally reserved for emphasizing important concepts and reviewing difficult material. The instructor reviews and clarifies graphs and figures in the text and applies them to the course material at hand. In addition, the instructor might give further insight from personal experience with the subject matter and clarify concepts and phrases that may not be familiar to all students. Ultimately the instructor administers quizzes and tests designed to assess student understanding of the material. These educational techniques take place in a particular sequence determined by the instructor who decides which chapters of the text are most relevant for the course and in which order they should be taught. Therefore, our question is, “Can we design an ALN that closely resembles this educational style?”

There are two aspects of the GDLM to consider: 1) the modes in which students will interact with each other and the instructor (modes of interaction), and 2) the on-line Mallard supplement which mimics and/or incorporates the instructional techniques of a traditional lecture (the Mallard supplement). The structure of the GDLM is illustrated in Figure 1. Electronic mail (e-mail), a course newsgroup, and a chat room all serve as interactive links between the students and the professor. The Mallard supplement provides automatic feedback through on-line quizzes.
in addition to explanations of graphs and figures, clarification of terms, and external links. The Mallard course material was designed to supplement the text. Thus, students are expected to work with the textbook available to avoid relying on the Mallard supplement as the sole source of information.

Modes of Interaction

One of the major improvements in present day distance education is the ability for students to communicate efficiently with each other and their instructor. Within the GDLM, students have three modes of interaction at their disposal. The use of a chat room (FirstClass, v. 3.5, SoftArc, Inc.) serves as virtual office hours for distance education students. The chat room also provides an opportunity for students to collaborate in real time with each other even though they may be many miles apart. Chat room sessions are recorded and placed on Mallard for the benefit of students who are not able to participate during the allotted time.

Interaction can occur, without time constraints, through e-mail and via the newsgroup. E-mail icons located at the bottom of each Mallard course material page allow students to address private concerns to the professor or the TA. The newsgroup, on the other hand, is primarily a forum for open discussion. Questions are posted to the newsgroup for consideration by the rest of the class. The professor offers input only after at least one other student has tried to provide an answer to the question. This promotes interactivity between the students. The students are able to impart their knowledge to each other in the same manner as on-campus students do at informal after class discussions.
The Mallard Supplement

**Technique 1 - Guided Learning**

Placing course material on the Web for perusal by students in no particular sequence would not allow the instructor to guide students through course topics. By providing a specific starting point and linking course material together, the GDLM maintains the instructor’s ability to decide the best manner in which the students should proceed. The starting point in the GDLM is a chapter introduction page similar to the one shown in Figure 2.

![Chapter Introduction and Outline](image)

**Figure 2. Chapter Introduction and Outline**

Balloons appear only in the “Getting Started Pages.” They are not shown in the actual supplemental material but are provided in Figures 2, 3 and 4 for the readers benefit.

The outline divides the chapter into two or three segments, each with unique learning objectives and text problem references as illustrated in Figure 3. The student is encouraged to read the corresponding sections of the text before proceeding with each portion of the chapter just as in a traditional lecture. A “Proceed to course material” link enables the student to embark on the journey through the guided distance learning course.
Technique 2 - Clarification via Course Material Pages
The content of a course material page is limited only by the imagination of the instructor. Important concepts can be explained using various forms of multimedia. Students can be given the opportunity to interactively explore concepts through the use of Java applets and specialized software packages. We chose to create interactive course material using only text, streaming audio and video, and external links, thereby minimizing the software requirements for the GDLM.

Clarification of important concepts in the chapter can be performed in a variety of ways. A rewording of the material in the textbook is often sufficient. Words or phrases in the explanation that may be new or unclear are linked to other explanation pages. Explanation pages become a means of providing review material for some students while allowing other students to continue on without superfluous information. Other means of clarification involve streaming audio and video. The opportunity to listen to a professor gives the Mallard supplement a classroom feel. The use of RealEncoder (RealEncoder, v. 5.1, RealNetworks, Inc.) software makes the audio available over a 28.8 baud modem. The video, however, is only useful when viewed over a high-speed connection and, for this reason, was only used once in the entire Mallard supplement. Questions from previous semesters were introduced along the way and the student was prompted to “Ask the professor…” for the answer. Voice clips were recorded and edited using SoundEffects (http://www.riccosoft.com/soundeffects/) software. Figure 4 shows the characteristic icons used whenever audio or video explanations were available.
In traditional lectures, the instructor often spends a fair amount of time reviewing figures and graphs found in the textbook. Since these illustrations often contain information vital to the comprehension of the material, this facet of traditional education is too important to be overlooked. Figure 5 illustrates the use of annotations within a redrawn figure pointing out the important concepts contained in the audio explanation. Added text and audio allows us to recreate an essential part of traditional classroom instruction.

A Web-based ALN provides easy access to relevant external web sites. Links to companies that manufacture or distribute devices described in the course material were made available to the students. Other external links gave students the opportunity to investigate certain topics in depth or examine related themes precipitated by the course material at hand. On-line course material can be easily updated and revised as needed, to include new insights or additional clarifications. Students can proceed at their own pace re-examining material they feel is especially difficult. Within the Mallard supplement, a student may return to material that has been previously covered but is not allowed to go on to the next chapter segment until he or she has fulfilled a predetermined criterion. The criterion may include the completion of certain course material pages, an interactive exercise, or an on-line quiz (discussed in the next section).
Technique 3 - Assessment through On-line Quizzes and Immediate Feedback

In traditional classroom education, instructors periodically use quizzes to diagnose problem areas and assess material comprehension. In Mallard, questions are automatically graded and students are provided with immediate feedback. Feedback from each Mallard quiz question is tailored to the answer provided by the student. If the student provides a correct answer, reinforcement of the concepts and ancillary information pertaining to the subject of the question is usually provided. In general, if a question is answered incorrectly a message appears with hints and additional inquiries guiding the student to material that may be helpful in understanding the question.

Specific feedback is also given based on the particular incorrect choice. When developing an effective multiple-choice question, there are often distinct reasons why each choice is either correct or incorrect. In this case, feedback addressing the specific reasons for the error is usually provided. The student is able to pinpoint the area where understanding is lacking and has the opportunity to correct the mistake. When a student is satisfied with the grade received, he or she can proceed to the next section of the chapter. When all segments are completed, an overall quiz

\[ t = \frac{\text{distance}}{\text{conduction velocity}} = \frac{D}{c + u \cos \theta} \]

Please explain the time difference associated with a transit-time flowmeter.

Click on this audio link for an explanation of Figure 8.9 (a) (shown below).

Figure 5. Audio and Visual Clarification of Figures and Graphs from the Text

* Specific information regarding the format of Mallard quizzes and quiz questions can be obtained at the Mallard Web site, http://www.cen.uiuc.edu/Mallard/.
is given before the student can begin the next chapter. The entire loop (e.g., chapter outline, course material, and quizzes) is repeated until all chapters in the Mallard supplement are completed.

Testing

The Guided Distance Learning Model was recently tested in a Medical Instrumentation course with a group of forty-five on-campus students at The University of Illinois at Urbana-Champaign. The students met with the instructor in person only on the first day of class where they were shown an overhead of the Mallard homepage and given the Mallard web address. The students were told that the purpose of the experiment was to simulate an off campus distance education course and reminded that they should not have face-to-face communication with the professor. They were allowed, however, to discuss the material together outside of class.

Within Mallard, a number of “Getting Started Pages” were created in order to give the students an idea of what they would be experiencing and of the formats that would be used throughout the Mallard supplement. The student’s first assignment was to review these “Getting Started Pages” and complete a short quiz. Course material was created in Claris HomePage (Claris HomePage, v. 3.0, Claris Corporation) maintaining a consistent format. Specific icons were used to identify audio and video links and students could count on a particular image warning them of an impending quiz. Each component of the Mallard supplement (chapter outline, course material, links, and quizzes) was illustrated and explained (a sample of these illustrations is shown in Figures 2-4). The “Getting Started Pages” also included information on minimum software requirements needed to run Mallard. In addition, a link was provided to the RealPlayer (RealPlayer, v. 5.1, RealNetworks, Inc.) site where students could download, for free, the software needed to operate the audio and video links.

Due to the experimental nature of the GDLM, only the first two chapters of the course were taught exclusively on Mallard. The students were tested on the material in these two chapters and the class reverted to traditional lecture format for the rest of the semester. Surveys were administered to the students regarding their experiences with the Web-based instruction and the Mallard supplement. The results and discussion of this survey are presented in the following section.

Results and Discussion

Out of the forty-five students who participated in this experiment, forty returned their surveys for analysis. In the following paragraphs, the results of these surveys are complemented by discussion to assess the following: technological barriers to the GDLM; e-mail, newsgroup and chat room use; and the overall effectiveness of the GDLM as an instructional tool. Although no statistical analysis was performed (a full study with enough data to be statistically significant was not feasible), we believe the results of this study to be indicative of overall GDLM performance. No comparison was made between the grades of students in this experiment and students who took the course in previous semesters. Such a comparison would not be conclusive since the experimental course was significantly different from the course offered in the traditional lecture format.
Technological Barriers

The ability to take full advantage of the multimedia capabilities of the Web will be important in further research. We chose, however, to accomplish our goals using only applications that were already familiar to the developers (additional audio and video software was easy to implement and available on-line by free download through the Web). This allowed us to concentrate on the effective design of the course material content and avoid placing a burden on the students by requiring them to master new software applications. All but four people indicated they had some previous experience with Mallard (72.5%), newsgroups (75%) or other types of Web-based instruction. It seems reasonable to assume that the students were not handicapped by unfamiliarity with the applications used by the GDLM (with the exception of the chat room software).

Many students complained, however, that their modems were too slow to conveniently access the Mallard supplement. Of those who were unable to use the audio/video clips, twenty-seven (90%) cited “technical difficulties” as the prime hindrance, adding that the computer systems did not support the proper software (students are not allowed to download software onto University computers). Some students mentioned that some computer labs on campus disallow any computer noise, which would include all audio streams used in the GDLM. Meanwhile, all of the those who were able to use the audio/video streams regularly (about 23%) found them helpful and almost half (44%) of those people rated them “very helpful.” These findings are consistent with the claim that the Web breaks down barriers of location and time, yet creates new kinds of obstacles that must be overcome.

E-mail, Newsgroup and Chat Room Use

Some students dread raising their hand in class for fear of asking, what classmates might label, “a dumb question.” The same concern could arise when faced with a newsgroup or chat room session. E-mail provides a safe environment for students to pose questions. When the instructor, in this experiment, received a question via e-mail that could be of interest to the entire class, the question was posted to the newsgroup explaining, “A student asked….” The professor would then reply to the student prompting them to consult the newsgroup. The professor offered a solution only after other students had made an attempt at an answer.

This method of temporarily withholding information seemed to promote interactivity between the students. The survey results suggest widespread use of the newsgroup, indicating that substantial interaction took place between the students and the professor. Twenty-eight people (70%) reported using the newsgroup. Of these, only two people (7%) found the newsgroup unhelpful due to the obscurity of questions and inability to employ diagrams and equations. Many students found that questions they intended to post had already been answered by the newsgroup. The students mentioned they enjoyed being able to see where they stood in relation to the other students and felt less in the dark about “what was going on with the rest of the class.”

Reaction to the chat room was not as positive. Most students were either unavailable during the scheduled chat room sessions or were not able to access the chat room at all. The fourteen people (35%) who reportedly used the chat room found it beneficial. One chat room user even noted that the chat room allowed students to express their own viewpoints, something they are not always comfortable doing in a classroom setting. Many of those who did not participate in the chat room sessions mentioned that chat room logs posted on Mallard were helpful. However, there was no evidence suggesting that students gained better access to the professor via the chat
Student learning is usually enhanced when they are immersed in an active learning environment \textsuperscript{14}. Students working with the GDLM are actively involved in the acquisition of knowledge rather than simply reading course notes on-line. As opposed to placing lecture notes on-line for perusal by the students in any sequence, the Mallard supplement allows the instructor to guide the students through the course material. The instructor decides in which manner and order to present the material, while the student is actively involved in acquiring this information in various forms (e.g., text clarifications, external links and audio/video explanations). Doherty suggests that the concept of learner control is an important element in the success of interactive learning environments \textsuperscript{15}. Throughout the GDLM course material, students are able to choose the amount and type of extra information they feel is necessary for comprehension of the material.

While the students could opt to use the audio clips and other information, the textbook was not an option. Students were often required to refer to the textbook in regard to the material presented in the Mallard supplement. Some references were made to actual sections of the text and others applied to graphs and figures that would be clarified by audio explanation (the ability to present streaming audio was valuable in addressing the issue of graph and figure clarification). References to the text were made in an effort to ensure that the students were not relying on the Mallard supplement as the sole source of information. In fact, a large number of the students indicated that they either “often” or “always” read the text before entering Mallard (82.5%). Exactly half the class admitted that they “don’t normally read the assigned text material but the Mallard supplement forced [them] to do so”. Similarly, twenty-seven people (67.5%) either “often” or “always” read the learning objectives before entering Mallard. Again, exactly half the class admitted that they “don’t normally read the section learning objectives but the Mallard supplement forced [them] to do so”. However, twenty-eight students (70%) indicated that they either “rarely” or “never” previewed assigned problems prior to proceeding with the Mallard supplement. Only ten people (25%) looked up the assigned problems ahead of time, even when prompted by Mallard to do so. However, the students were not able to completely ignore the suggested text problems; the suggested text problems were incorporated into the quiz at the end of each chapter. The survey results suggest that the Mallard supplement had a positive effect on student study habits by forcing them to read the text material and learning objectives.

Another technique employed by the Mallard supplement was the use of on-line quizzes and immediate feedback. It has been noted that one of the most common forms of teaching is questioning \textsuperscript{14}. Distance education should be no different. In fact, the Web can enhance the process by taking the burden of grading quizzes off of the instructor or TA. On-line quizzes via Mallard also allow instructors to tailor feedback to the specific incorrect answer choice. Kashy et al. confirmed that the use of immediate feedback, making students aware of what they do not know, increases understanding of the material \textsuperscript{8}. Thirty-five students (87.5%) either agreed or “strongly” agreed that the Mallard quizzes helped them learn the course material. When asked directly, twenty-five people (out of 33 responses, or 76%) agreed (another 4 people, 12%, “strongly” agreed) that the Mallard course material supplement also helped them to understand the course material. Along these lines, thirty-two students (80%) agreed or “strongly” agreed that the Mallard supplement “answered questions that arose while reading the text”. In addition, having participated in the experiment, twenty-eight people (70%) agreed that “Web-based
instruction is a useful learning tool”. The overall, effect of the GDML on student comprehension of the course material was positive: a total of thirty-seven out of forty respondents (88%) felt that the GDLM was effective in helping them comprehend the course material.

Summary

The Guided Distance Learning Model is presented as an effective alternative for students who would otherwise have no access to higher education. The ability to provide graphically based responses, and the opportunity for students to incorporate illustrations in newsgroup and chat room discussions, will be important in future studies. The focus of the preceding research, however, is the instructional design of distance learning. The Guided Distance Learning Model takes a step forward in the integration of traditional educational techniques into distance education courses.

Bibliography


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