A First ALN Experience: Issues, Lessons and Emotions

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I. Introduction

This paper presents an "early adopter's" first experience using asynchronous learning networks (ALN) teaching/learning techniques in a sophomore course offered to students on-campus. This paper will present a "nuts and bolts" discussion--not views on educational theory or philosophy (important topics; but topics for a different paper). This paper begins with the factual background data of this experience, followed by some of the several issues that an early adopter much consider, some of the important lessons I learned, some of the emotions that I and my students experienced, and finally a couple of concluding comments.

II. Factual Background

All this experience is with EE201, Electric Circuits, a course that is required for students in the electrical engineering and in the computer engineering curriculums at Iowa State University (ISU). This course has the very traditional content of a first course in electric circuits. The textbook is Electric Circuits, Fifth Edition, by James W. Nilsson and Susan A. Riedel, Addison Wesley, 1996. (I am told that this textbook has more than 50% market share.) ISU has 15 week semesters.

A. Fall 1997

The class met on Tuesdays and Thursdays for 80 minute sessions; two other sections of this course were available. Seventy eight students began the course in my section; 62 students received letter grades at the end of the semester. I did not require class attendance; however, most students attended every class session. I used a traditional, public web site and a list serve throughout the entire semester.

Because the secure web server for this course was not available at the start of the fall 1997 semester, for the first five weeks of the semester, students submitted homework on paper at each class period; it was graded and returned at the next class period. The web server for the instructional delivery and administration became operational about week six of the semester and all student homework was then done via the computer software, "Mallard™". When Mallard™ came on-line, we also began to use a local newsgroup. We produced 85 computer based problems.

I was assigned about 0.5 FTE to this effort; an instructor (beginning graduate student) was assigned 0.25 FTE; and four undergraduate students each worked about 6 hours per week. The undergraduates were hired using funds from an internal ISU grant[1] received to support this effort.

(The proposal that I wrote to obtain the internal grant contains several references[2-8] of interest; these are listed below.) At the end of the semester students completed an extensive evaluation of their computerized instructional delivery and administration experience.

B. Spring 1998

The class meets on Tuesdays and Thursdays for 80 minute sessions; one other section of this course is available. Fifty four students began the course in my section; 52 are still registered for a letter grade as of the end of week seven of the semester. Virtually all homework for this offering is being done via Mallard™. By the end of the semester, I estimate that we will have a total of over 200 computerized problems developed. I use a traditional, public web site, a list serve and a local newsgroup.

I am assigned about 0.5 FTE to this effort; nine undergraduate students each work about 6 hours per week. The undergraduates are hired using funds from an internal ISU grant[1] received to support this effort.

At the end of the spring semester, students will complete the same extensive evaluation of their experience. The oral presentation of this paper will include data from the two student evaluations.

III. Issues

For an early adopter of this teaching/learning technological approach, the first decision is to select the software that will be used. Often the selection of software will determine which server should be selected. Several significant improvements in student learning can result from the use of this technology.

A. Instructional Software

The good-news/bad-news of the current situation is that many different software systems are available to deliver and administer instruction using the Internet (sometimes referred to below as WWW). Thirty different software systems are listed in Table I at the end of this manuscript. New systems seem to be announced weekly; some systems disappear mysteriously without a trace.

An early adopter has a very difficult task to select which software system(s) to use. A list of criteria to be considered is presented in Table II at the end of this manuscript. (Table II is adapted from a private communication from Dr. M. Albright, Iowa State University.) My rank ordered list of important factors is:

1) Try to select a software system that will survive the shakeout in this industry that surely must come.

2) The selected software must have the functionality necessary to accomplish the faculty member's instructional objectives.

3) It is better to select a software system that is likely to be adopted by others within the department, college, and/or campus. (It is advantageous to have a local community of users with whom to share experiences, solve problems, *etc.*)

4) The selected software should perform equally well on both PC platforms, Mac platforms, and/or Unix workstations.

5) The selected software should perform equally well when using either Netscape or Microsoft Internet Explorer.

Which brings us to the question of why I selected Mallard™. I have divided the reasons for this selection into two categories: primary and secondary considerations.

The primary reasons for my selection of Mallard™ in rank order are:

1) Mallard™ will survive; it is strongly entrenched at the University of Illinois and is in the process of being commercialized.

2) My department and my college had virtually no experience with ALN delivery and administration of instruction as I began. Therefore using software that is in widespread use at one of the very best engineering colleges and perhaps the best department of electrical and computer engineering was an important consideration for "political" acceptability.

3) Mallard™ has the mathematical, computational functionality necessary for an introductory circuits course. Mallard™ can evaluate algebraic and Boolean expressions as well as true/false, multiple choice, and fill-in-the-blank questions. Mallard™ allows random values to be programmed into problems so that individual students typically get different values in their problem statements. I expect additional, more powerful computational functionality will be added over the next few years.

4) Students do not need any special software on their machines; only a standard Internet browser (*e.g*. Netscape or Microsoft Internet Explorer) is required of students.

5) Mallard™ uses a secure server so that student grades can be kept on the server. Mallard™ graded problem scores are automatically recorded; other student grades (*e.g.*, examination scores, paper-and-pencil homework scores, laboratory scores, etc.) can be uploaded; class averages can be uploaded. Each student can thus know all his/her own scores and how his/her scores compare with the entire class.

The secondary reasons for my selection of Mallard™ in no particular order are:

1) Mallard™ is very user-friendly to students.

2)Mallard™ is reasonably user-friendly to faculty and instructional developers.

3)Mallard™ accommodates easy and clear integration of a traditional, public web site, the use of a newsgroup, and the use of e-mail.

4) Mallard™ offers a very wide range of automatic grading policies that involve the number of tries permitted without penalty, penalties for exceeded the permitted number of tries, late penalties, letter grade cutoffs, *etc.*

5) Mallard™ can run on a Silicon Graphics (SGI) web server. (To understand why this was a consideration, see the discussion on server selection below.)

Finally, the decision to select Mallard™ has proved to be a good one from the perspective of technical support from the University of Illinois. They have provided virtually instantaneous assistance to each problem we have encountered and the answer to each question we have asked.

B. Server Selection

I am not an expert in Internet servers and I do not know Unix, C, C++, Java, cgi, or any other powerful, high level computer languages. Hence my initial bias was to seek instructional software that could be operated in a simple Windows environment. I quickly learned that most of the more powerful instructional software systems operate in a Unix environment (including Mallard™). At this point, I was forced to rely on others' expertise.

I approached the ISU Computation Center and asked if they would provide the necessary server hardware and technical support; they would do so only if I provided the money to buy a new server and to hire the technical support. I approached the College of Engineering Computing Support Services and I encountered a political struggle between them and my department over who would "control" which computers in the college.

My department is strongly committed to the use of SGI machines (Ed McCracken, Chairman of the SGI Board of Directors, is one of our alums). Hence others in my department decided that a particular SGI machine could and would be made available for this effort. One of our technical support persons who is well trained in SGI platforms was assigned to provide the technical, server support that I needed (and continue to need).

For the early adopter on some other campus, I suggest that the server be selected such that the maximum amount of technical support is available at the least cost.

One important server issue has arisen in our experience--server response time. We have only a relatively few students using our Mallard™ server, yet response times are sometimes measured in minutes. We have be unable to determine with certainty whether the slow response is a server problem or a network problem. Nevertheless, I have requested a new, faster, more powerful server for this effort.

C. Learning Issues

I believe strongly that the best way for students to learn engineering is for them to solve correctly a great many problems. The use of ALN teaching/learning techniques in general, or the use of

Mallard™ in particular, provides the following advantages over more traditional classroom and paper-and-pencil teaching/learning (in rough rank order):

1) Typically each student has a different set of numerical values within the problem statement. Thus, students can help each other with the solution approach and are not able to share numerical answers.

2) We are able to program require multiple student responses within a single problem. Thus, we are able to lead the student through the solution of complex problems in a step-by-step fashion; if the student makes a mistake somewhere in the solution, the student can know on which step of the solution he/she erred.

3) Students get their homework graded instantly, 24 hours/day, 7 days/week. Thus, when the students' work is freshest in their minds, they get positive reinforcement for correct work and corrective feedback for errors.

4) I allow students to have 10 tries at each homework problem before the deadline without penalty. Allowing 10 tries without penalty encourages and enables every student ultimately to solve every homework problem perfectly. (In spite of this, a typical class average score on Mallard™ homework is about 85%.)

5) Mallard™ keeps the highest score earned on each problem. Therefore students can solve all the homework problems again (getting different numbers that originally because of the randomness programmed into some values) as they study for hourly exams and/or the final exam.

IV. Lessons Learned

I have divided lessons learned into two categories: primary and secondary.

Two primary lessons that we have learned are:

1) ALN instructional delivery and administration requires lots of work. We began by creating original problems then coding them; later we got permission from the publisher of the assigned textbook to adapt problems from the textbook for use within Mallard™. Still, we estimate that two to three person hours are required to create, code, and check each Mallard™ problem. (Since Mallard™ currently does not do complex arithmetic, we have to code separate answers for the real and imaginary (or magnitude and phase) parts of complex values. Since Mallard™ does not do matrix algebra, we have to solve the matrix equations by hand/calculator then code Mallard™ answers accordingly.)

2) Problems that are made available to students must be PERFECT. Unfortunately, during the fall 1997 semester, too many times, we made Mallard™ problems available to our students when the problems contained coding errors such that when the student solved the problem correctly, Mallard™ told them that they had an error in their solution. After only a few such experiences, the students became very frustrated, and in some cases, angry to the point of becoming very negative about the concept of doing homework via an ALN system.

Some of the secondary lessons that we learned are:

1)Netscape and Microsoft Internet Explorer are not identical. Web site software that employs Java, cgi scripts, etc. may or may not function as designed in one or the other browser. Mallard™ tends to be designed for Netscape on a PC platform; hence Mallard™ occasionally encounters difficulty when students use MS Internet Explorer or try to work from a Macintosh platform or a Unix workstation.

2)As noted just above, Macintosh platforms, PC platforms, and Unix workstations have sometimes-significant differences.

3)Expertise sufficient to operate and to maintain the server is essential for the successful delivery and administration of instruction via ALN techniques.

4)Because of the above lessons learned, it is often difficult for students to use the open computer laboratories of the university; it is better if they have their own PC with their own connection to the Internet (or the campus network).

V. Emotions

I divide the emotions that I and my students experienced into two broad categories: frustration and satisfaction.

A. Frustration

1) My frustrations included (and probably were not limited to--but since I tend to repress unpleasant experiences, I can't remember any others):

1-a. I was frustrated in my attempt to get campus wide agreement on which two or three ALN software systems Iowa State University would concentrate. I convened an *ad hoc* group of faculty and administrators over the summer 1997 then passed the leadership of the group to people from the ISU Instructional Technology Center. (They had the vested interest in this discussion.) After hours of meetings, we finally concluded that we could not agree on 2 or 3 systems. (This discussion was made a bit more difficult because the ISU Computation Center had developed its own web-based instructional delivery system--ClassNet.) The non-engineering faculty among the discussion group had no need for the software to be able to evaluate mathematical functions and these non-engineering faculty also had a high need for computer-based student discussion groups. In the end, I decided on Mallard™ unilaterally.

1-b. I was frustrated by the political struggle over who would control my server. This struggle delayed bringing my server on-line until about week 6 of the fall 1997 semester.

1-c. I was initially frustrated at how hard it was for me and my undergraduate student helpers to create PERFECT problems. We sometimes made silly mistakes. We sometimes made unthinking assumptions based on our greater experience that beginning students could not make. We finally evolved a system where we began with a textbook problem for which we had a

solution; coded the problem with the textbook values and ensured that our coding was correct. Then we put random values in for one or more circuit elements. Generally one student coded the problem, another student checked it, then I checked it before I made it available to my students.

1-d. I was surprised at the large amount of my time that this effort took. Many hours went into learning such simple things as symbols so routinely available in a PC platform are not available in a Unix workstation environment--*e.g.*, μ, ω, Ω, π, ≥, and ≤. Many hours were spent defining the format (appearance) standards we would use for our Mallard™ problems; then many more hours were required to ensure that the undergraduate student developers adhered to the standards.

1-e. I am disappointed that only one of my colleagues has shown any interest in trying Mallard™ in his/her courses.

2) Student frustrations included, but were probably not limited to the following:

2-a. In fall 1997, my students were frustrated to the point of anger with our coding errors. Even at the end of the fall semester, when we were perfect in our coding, students would make mistakes in solving the problems and would assume that Mallard™ was programmed incorrectly. (In retrospect, I am surprised that I did not have an open, armed rebellion of students in fall 1997.) In spring 1998, we have made only a very few coding errors; so, this semester my students do not have this frustration.

2-b. In fall 1997, I took full advantage of the new flexibility offered by ALN techniques to make problems due at any time that I chose. I often had homework due at midnight on Friday or Saturday night (thinking that students would appreciate this); however, it became clear in the end-of0course evaluations that students hated having homework due at "weekend times" especially when these times were at the beginning of a vacation period. Students seem to want their homework to be due at the times of the scheduled class; so, in spring 1998, all homework is due at the time of the start of class each Tuesday and Thursday. Students seem to like this.

2-c. In fall 1997, when Mallard™ came on-line, I discontinued working out the homework problems in class because Mallard™ provided instant grading of these problems. In was clear in the end-of-course evaluations that students still wanted me to show them how to do the Mallard™ homework. In spring 1998, I begin each class period by discussing the Mallard™ homework problems that were due minutes ago.

B. Satisfaction

I'll lump my satisfactions together with the students' satisfactions:

1. I am very satisfied that once the large initial effort of creating computer-based homework is completed, these problems can be used for several following semesters with virtually no additional effort. Thus, students for several semesters can be assigned many problems; students can solve them and submit their answers to the computer; the computer can instantaneously grade the students' solutions 24 hours/day, 7 days/week.

2. Once the coding is completed, the computer can accommodate hundreds of students with no additional faculty effort. Students on multiple campuses, and enrolled in multiple curricula can be accomodated.

3. I like the fact that my students are getting immediate feedback on their work at times of the day and days of the week that they choose. I like giving my students multiple attempts at each homework problem without penalty. These factors seem to encourage mastery learning of the concepts of the course.

4. My students commented that they like the instant feedback on their work.

5. My students commented that they liked problems that required them to provided answers along the process of a step-by-step solution of a complicated problem. They liked the feedback that enabled them to learn in which step of the problem they make their mistake.

6. I and my students liked the secure communications that allowed me to provide their individual grade information and information on class averages via Mallard™. For example, I would give an in-class exam on Thursday afternoon. Immediately after the exam, I would post the solutions to the exam questions in the public course web site. Immediately after grading the exam and entering the scores into a spreadsheet, I would upload the spread sheet into Mallard™. Then I would send an e-mail message via the course list serve to inform all students that they could learn how they did on the exam via Mallard™. Typically, all this was accomplished within 24 hours after the exam was given (and well before the next meeting of the class on the following Tuesday.)

VI Concluding Comments

Given the large effort required for delivering and administrating instruction via Mallard™ or any other ALN software, I think we must find ways to share this effort across campuses. This seems to be analogous to the transition from writing notes for one's own students only to evolving those notes into a textbook that can be used on many different campuses by many different instructors.

I am glad that I have had this experience. I fully intend to continue to provide instruction via ALN techniques. I encourage others to join in the fun.

1. 1st Class	16. Mallard (Univ. IL)
2. ACE Link (Univ. IL)	17. Nicenet
3. ACTV Interactive	18. Pacer Forum (ACE Logic Inc.)
4. AIM Lab (Univ. IL)	19. Phenoix for Windows (Pathlore Software Corp.)
5. Authorware 4 (Macromedia, Inc.)	20. Podium
6. Class Net (IA State Univ.)	21. Quest Net+ (Allen Communications, Inc.)
7. Class Web (Global-Reach Interenet Publications, Ames, IA)	22. Quest Writer (Oregon State Univ.)
8. Cold Fusion (Allaire Corp.)	23. Toolbook II (Asymetrix Corp.)
9. Cyber Prof (Univ. IL)	24. Top Class (WBT Systems Inc.)
10. Daedalus	25. Virtual Classroom Interface (Univ. IL)
11. Digital Link	26. Virtual-U
12. Digital Trainer	27. Web Course in a Box
13. Icon Author (Aimtech Corp.)	28. Web Notes
14. Instructional Management System	29. WebCT
15. Learning Space (Lotus Development Corp)	30. WEST Desktop Education Server

Table I List of 30 Different Instructional Software Systems

Accessibility
Proprietary software required?
Accessable via WWW or must some proprietary network be used?
Software run on Macs and PCs?
Software work with Netscape and MS Internet Explorer?
Presentation of Course Content
Integrate text and media on same page?
Easy interface with WWW?
Handle scientific notation?
Allow random numbers in problem statements?
Perform algebraic computations with real and/or numbers?
Perform symbolic computation?
Perform differential and/or integral calculus?
Perform Laplace and/or Fourier transforms?
Perform Boolean evaluations?
Handle Java and/or cgi script?
Include area for supporting materials?
Communication Tools
Threaded e-mail?
Include attachments with e-mail?
Special groupware required for e-mail?
Allow discrete and distinct discussion groups?
Include chat rooms?
Management Tools
User manual available? In hard copy or on-line?
Security available? Used?
Assignment submission allowed? how?
Suitable for exams?
Perform test item analysis?
Allow various grading systems?
Allow students in different sections of same course?
Support Issues
Who (which department, college, center, etc.) will support hardware?
Who (which department, college, center, etc.) will support software?
Will vendor of software support? To what extent? How?
User community in existence on-campus?
Server/Licensing Issues
Server requirements?
Software costs/pricing?
Licensing costs/pricing?
Support costs/pricing?
Miscellaneous
Steepness and duration of learning curve for faculty and/or students?
Will this software survive the shakeout that is sure to come?

Table II Selection Criteria (adapted from a private communication by Dr. M. Albright)

Mallard™ is a registered trade mark of the University of Illinois, Urbana IL. The Mallard™ software is copyrighted by the University of Illinois, Urbana IL. For general information on Mallard™, see http://www.cen.uiuc.edu/Mallard/.

1. The internal proposal I wrote to obtain the financial support to begin using ALN teaching/learning techniques is found at http://class.ee.iastate.edu/rmander/BobAnderson/MillerProposal.html.

2. "Virtual Learning Superior to Traditional Instruction," Jerald Schutte, Professor of Applied Statistics, California State University at Northridge, News Com Jan. 17, 1997. Students learning in a virtual classroom (using text posted online, e-mail, newsgroups, chat, and electronic homework assignments) tested 20% better than their students who learned the material in a traditional classroom.

3. "CyberProf™;", presented by Alfred W. Hübler, Assistant Professor of Physics, University of Illinois at Urbana-Champaign, SCALE Fall Retreat, Urbana, IL, October 11, 1997. The use of an interactive, asynchronous instructional delivery and administration system (CyberProf™;) in the introductory physics course over the past few years has led to dramatically increased student comprehension of fundamental principles. Course examinations are now so difficult that many professors in the department find it difficult or impossible to solve some of the examination problems. (For additional information on CyberProf™;, see note 5 below.)

4. The Sloan Foundation's program in Learning Outside the Classroom has a central theme of exploring new outcomes in science and engineering higher education which are made possible by asynchronous access to remote learning resources through current, affordable technology. For details, see http://www.sloan.org/education/ALN.new.html Sloan sorts ALN applications into three different categories: 1)At or Near Campus (currently funding 6 projects at 5 different universities), 2)Commuting Distance to Campus (currently funding 17 projects at 14 different universities) and 3)Very Far from Campus (currently funding 12 projects at 11 universities).

5. The Sloan Center for Asynchronous Learning Environments (SCALE) is one important focal point for ALN efforts at the University of Illinois at Urbana-Champaign(UIUC); see http://w3.scale.uiuc.edu/scale/. The Web Support Initiative at UIUC was created to provide general university level support to faculty who are developing ALN courses; for details, see: http://wsi-www1.cso.uiuc.edu/index.html. The Virtual Classroom Interface (VCI) is currently being used by 36 courses at UIUC; VCI is described at: http://wsi-www1.cso.uiuc.edu/vci_index.html and an example of the VCI look and features is at: http://ampere.scale.uiuc.edu/aim/vci2.5/. The Mallard™; instructional delivery and administration system is described at: http://www.cen.uiuc.edu/Mallard/. Nine courses are currently using the Mallard™; system. CyberProf™; is yet another ALN system developed and in use at UIUC; for details, see: http://cyber.ccsr.uiuc.edu:80/cyberprof/.

6. The expertise at Vanderbilt University is demonstrated by the paper, "A Model for On-Line Learning Networks in Engineering Education," by J.R. Bourne, *et. al*, published in the Journal of Asynchronous Learning Networks, Vol. 1, Issue 1 March 1997. See http://www.aln.org/alnweb/journal/issue1/bourne.htm. Vanderbilt's Center for Innovation in Engineering Education is conducting an evaluation of Sloan ALN projects and it is also the host site for the ALN web with its associated on-line ALN magazine and ALN journal.

7. ClassNet is an ALN system developed at Iowa State University. For details, see http://classnet.cc.iastate.edu/help/what_is_classnet.html.

8. Also see, "A Virtual Classroom Approach to Learning Circuit Analysis," B. Oakley, II, IEEE Transactions on Education, Vol. 39, No.3, Aug. 1996, pp287-296.

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