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Effects of Deadline Contingencies in a Web-Based Course on HTML

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by

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A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
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Major Professor: James White, Ph.D.

Dedication

Dandelion seeds
explore world on Gentle Breeze
and eagle sours high.

Butterfly dances
in magical field of light
and new found wonder.

This work is dedicated to Daniel, who takes me places and lifts me higher than I ever dreamed possible, and to Samantha, who makes my heart dance.

Acknowledgments

There are many who made this work possible and helped to improve its quality. I wish to thank them all sincerely. My husband, Daniel, who never tired of sharing his enthusiasm, support, and insight, and my daughter, Samantha, made many sacrifices and were ever patient and understanding. My mother, Gloria Strother, saved my life in 1986 and showed me how far you could go with a dream to guide you, courage to believe in yourself, and the drive to work hard. She, along with my other parents, Rose Marie and Ambrose Majchrzak and Dorsey Strother, supported me unconditionally and spent many quality hours caring for Samantha. My grandfather, Dr. William C. Tremmel, set the bar with his own achievements and my grandmother, Opal “Mike” Tremmel, was one of my greatest cheerleaders. I miss her dearly and will never forget how special she made me feel, like I could accomplish anything. My father, James Tremmel, grandfather, Wilber Johnson, and dear friend, Michael Pokorny, also have been steadfast in their support.

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An Abstract

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Current learner-centered trends, such as supplying students with content on demand (CoD), coupled with research findings that indicate distributed practice is superior to massed practice in terms of increased memory function and that the Personalized System of Instruction (PSI) is superior to traditional instruction in terms of academic achievement, content retention, and student satisfaction, prompted an investigation merging these two lines of research. Although PSI is more feasible today based on advances in technology and students prefer its self-paced component, they often procrastinate. In fact, this problem is resurfacing in distance education courses and is reflected in low completion rates as well as in the number of nonstarters. Numerous researchers have used deadline contingencies to reduce procrastination without adversely affecting student achievement and satisfaction, but few have considered the benefit of enhanced memory. It was hypothesized that, by providing students with CoD, a lesser form of self-pacing, and by using contingencies to regulate the pace of assignment submissions, procrastination would be reduced and content retention subsequently increased without detriment to immediate achievement and student satisfaction. To quantify differences in procrastination level, a comprehensive, sensitive, and reliable measure of procrastination, called the rate of relative digression from a target response (RDTR), was proposed. Undergraduate, preservice teachers in an instructional technology course were randomly assigned to one of three treatments. All groups were given the same deadlines. For one treatment, the deadlines were recommended (R) with one absolute deadline at the end of the treatment interval. For another they were conditional (C) with opportunities to earn bonus and penalty points for early and late work. For a third, they were all absolute (A) with no assignment accepted for credit after its due date. Although many problems experienced by students in A made findings for this group inconclusive, analysis of differences between students in R and C indicated that C was superior in reducing procrastination and enhancing memory function without detriment to immediate achievement, pacing preference, and course satisfaction. Although more research is needed to replicate, extend, and clarify findings, these results support using conditional deadlines for assignments when learners are supplied CoD.

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Chapter 1

Introduction

Educational systems appear to be moving rapidly toward a more learner-centered paradigm in which teachers act as facilitators, coaches, and tutors and students access electronic content individually or in small, cooperative groups, have more input regarding topics of exploration, interact with engaging media elements, and are assessed based on their progress on relevant tasks as well as the quality of the products they produce rather than solely on their performance on achievement measures (Wilkes, 1996). This is evident in the amount of traditional course material being converted for online delivery, as more courses become available daily for the distant learner. Furthermore, according to the keynote address by W. Graves to attendees of the Association for Learning Technology Conference in 1994, "600 US universities and colleges, plus 100 corporate associates, are busily planning a National Learning Infrastructure Initiative which could remove constraints of time and place from much of US higher education" (Hawkridge, 1995, p. 5).

Of course, at present, many classes are still conducted on campus. In the traditional classroom setting, teachers often face the challenge of determining how best to meet simultaneously the needs of many students with varied backgrounds and skills. Many feel that the lecture method offers the most economical means of accomplishing this task. Although this instructor-paced method of delivering content does allow the lecturer to transmit abundant, well-organized information to a large audience in a short amount of time, it does not follow necessarily that the information is effectively received by the intended recipients for, at least, two reasons. First, instructors traditionally have taught to the *middle level* student, moving too quickly for slower students to comprehend all of the material and moving too slowly to keep faster students continuously engaged. Second, research indicates that students are not able to listen efficiently for extended periods of time, recording fewer important facts as the lecture progresses (Bonwell & Eison, 1991).

Some teachers of on-site courses are attempting to address the needs of individual learners by meeting students in computer laboratories where they can demonstrate skills, engage students in active learning, act as facilitator and tutor for a large number of students at once, and allow each student to progress through the material at his or her own pace. In addition, many are augmenting their instruction with online material that can be accessed on demand, or content on demand

(CoD). Instructors also are using online computer management packages to track student progress and the Internet as a vast resource as well as a means of communicating synchronously and asynchronously with their students.

Proponents of Asynchronous Learning Networks (ALN), which can be used for distance as well as face-to-face education, hope that by making resources available online, supporting communication and collaboration between learners and teachers, and focusing on such interactions (rather than on the limited interactions possible with the strict lecture format) instruction will be more cost effective and readily accessible to the masses. In addition, they hope self-pacing will become "a realizable goal" (Mayadas, 1994). Making information available to a large number of students online and on demand, along with software tools for managing the submission and grading of assignments and for tracking student progress, do contribute to the feasibility of self-pacing for distant and on-site learners.

Advances in technology make it possible to explore new instructional paradigms and to take a second look at old ones. Now that learner-centered self-pacing is a viable alternative, on-site and distant learners can reap the benefits of such a paradigm shift. For example, Keller's Personalized System of Instruction (PSI) includes self-pacing and access to CoD, a lesser form of self-pacing, as two of its five features. PSI warrants renewed interest based on its ability to improve immediate achievement and retention test scores (Kulik & Kulik, 1975), its popularity with students (Kulik, C. Kulik, & Cohen, 1979), and its support of teachers and assistants acting as tutors for individual students.

Unfortunately, complete self-pacing is associated with some well-documented problems. First, students tend to procrastinate (Lamwers & Jazwinski, 1989; Rae, 1993). This contributes to higher drop-out and failure rates as well as to a substantial shifting of workloads for graders toward the end of a course. Second, it is hard to accommodate self-pacing in many current educational institutions, which require that courses be completed in a given time frame, that lessons fit nicely into a fixed time period, and that grades reflect what a student is able to accomplish under these conditions (Keller, 1981). Furthermore, it is more difficult to keep the grading of assignments consistent when they are coming in at different times, and initially, it can be time consuming to develop instructional materials. There are also the issues of determining who owns the rights to course materials (intellectual property), and the lack of systematic rewards for instructors who develop such courseware (Lloyd & Lloyd, 1986).

Many of these same difficulties are resurfacing today in distance learning environments. In particular, Hiltz (1997) lists the following issues faced by the New Jersey Institute of Technology's ALN, the Virtual Classroom: student procrastination, higher dropout rates, more incompletes, home equipment and dialup problems, difficulty in grading, the need for more instructional assistants as the number of enrolled students increases, substantial time required to make initial instructional materials, ownership of instructional materials, compensation for production of materials, and the need for a reduced workload during such production. Furthermore, retention "or 'drop-out' rates have been of concern to distance education institutions internationally for decades" (Evans, 1995, p. 70). Gillard (1993) argues that distance education is, in essence, individualized education. One aspect of individualization, self-pacing, and its associated higher levels of procrastination, may account for some portion of the distant learners who drop-out, especially given the fact that many do not complete any course assignments at all. Bȧȧth refers to such students as *non-starters*. Of course, another possible explanation for drop-out rates is the isolation felt by some distant learners. In fact, both procrastination and isolation may operate together to produce drop-out rates that are sometimes as high as 50% (Holmberg, 1989). In any case, while the learner is afforded more freedom in a distance education course, s/he is also required to take a greater responsibility in his or her education.

A learner-centered environment offers the mature learner many advantages, such as greater input on topics explored and self-paced access to rich media elements on demand. However, the negative effects of procrastination may outweigh such benefits. Many researchers have explored the possibility of supporting individualized instruction, while reducing procrastination. Research indicates that incorporating deadlines in personalized instruction can improve pacing without detriment to achievement (Lloyd, 1978). Therefore, using a lesser form of self-pacing where students still have deadlines for assignments, but are able to access all content on demand, may mitigate student procrastination, yet still allow for some level of self-pacing along with associated benefits. In a glossary compiled by Kaplan-Leiserson (2001), CoD is specifically defined as "delivery of an offering, packaged in a media format, anywhere, anytime via a network" (Kaplan-Leiserson, 2001).

Deadlines may have an additional benefit for the student. While using deadlines has not been shown to improve consistently immediate achievement scores, it may have a positive effect on retention test scores, because it forces students to space out their exposure to the material, rather than to mass it all at one time. Although some researchers have found that spaced versus massed exposure (or cramming) to content yields comparable scores on immediate achievement measures, they also have reported that spaced exposure can enhance memory function, and hence, retention test scores (Bloom & Shuell, 1981). Other evidence suggests that deadlines may not have a significant impact on retention test scores (Robin & Graham, 1974; Morris, Surber, & Bijou, 1978), but more, well-controlled research is needed. Also, students report a strong preference for self-pacing. Enforcing deadlines may jeopardize affective benefits and deny students the opportunity to learn how to manage their own learning. Providing students with CoD allows them to have self-paced access to course content, yet requires them to meet deadlines for completing assignments based on that content. By providing CoD, it is hypothesized that the affective benefits of self-pacing can be maintained, while mitigating the problem of procrastination, encouraging a distributed pattern of practice, and raising the level of content retention.

The challenge is to maintain student control over pacing, while placing contingencies on the student that encourage the timely completion of assignments. Many researchers have investigated the merits of using deadline contingencies with personalized instruction. Although many alternatives have been explored, some of the easiest to manage involve awarding bonus points for early work and deducting penalty points for late work. Findings indicate that such bonuses and penalties are effective in motivating students not to procrastinate (Glick & Semb, 1978a). Often, the penalties employed have been harsh. In one case, 25 points were deducted for each day late. In other cases, no credit was awarded for late assignments. Some investigators even forced students who missed deadlines to withdraw from the course (Glick & Semb, 1978a).

In order to explore the effects of procrastination on retention test scores, three deadline contingencies were applied to the completion of assignments by students in an introductory instructional technology course at a large public university in the southeast. Bonuses and penalties were used, because they have been shown to be effective in reducing procrastination and because this approach is relatively easy to implement as compared to other approaches like ones which require negotiating contracts with individual students. The students were all given the same set of deadlines and were randomly assigned to one of three treatments, which varied by deadline contingency along a continuum with respect to harshness. For one group, deadlines were *recommended* (R) only. For another group, they were *conditional* (C), with bonus points awarded for work submitted early and penalty points deducted for work submitted late. For the remaining group, they were *absolute* (A), requiring that assignments be submitted by the deadline in order to receive any points.

Outcomes along three dimensions were considered: achievement, student pacing preference, and procrastination level. It was expected that scores on a posttest given immediately after the treatments were administered would replicate the findings of other researchers and indicate that there was no significant difference in achievement levels for different deadline contingencies. In contrast, it was anticipated that scores on a measure of retention given one month later would indicate an advantage for students in groups C and A, because they would be forced to space out their exposure to the course content rather than be able to mass all of their learning near the end of the treatment interval. Such massed learning would occur for students in group R, if they did tend to procrastinate more, as anticipated. Careful records were kept of when students submitted each assignment, so that this suspected higher level of procrastination could be verified. In addition, procrastination was gauged by how often students requested deadline extensions.

The teaching assistants (TAs) were asked to record when they received excuses from students for late work and requests for additional time.

In order to investigate the effects of deadline contingencies on student satisfaction, a self-report measure on pacing preference was administered with the posttest. Although research indicates that students prefer PSI over traditional instruction, and some have shown that applying certain deadline contingencies has no effect on course satisfaction, it was not clear how the inclusion of the deadline contingencies proposed by the current study might affect preference for self-pacing. No effect was anticipated. However, if one did exist, it was expected that students in C and A would report a lower preference for self-pacing with students in A reporting the lowest preference. Although conditional and absolute deadlines may be advantageous in reducing procrastination, enforcing such contingencies may come with an affective cost for students. Assuming such a cost and that the utilization of some type of deadline contingency is warranted by higher retention test scores and reduced end of course workload, conditional deadlines may be a better choice than absolute deadlines. Although more difficult to administer[1], they may create less angst for students. Again, survey results were analyzed with the expectation that deadline contingencies would not significantly impact student satisfaction with self-pacing.

1.1 Purpose

This study examined which was more advantageous when students are provided with CoD – recommended, conditional, or absolute deadlines. It was hoped that deadlines would reduce procrastination, while student satisfaction would be maintained by allowing students to access content on demand. It was expected that reducing procrastination would make the course easier to manage for graders and might result in improved learning for students. The ideal contingency would reduce procrastination levels, would not adversely affect immediate achievement scores or preferences for self-pacing, and would improve retention test scores.

Findings from this study may have important implications for teaching in general, but should generalize best to local and distant adult learners who access CoD. If results replicate the work of others and indicate that deadlines effectively reduce procrastination without detriment to initial achievement, this study will provide further evidence that deadlines are an important component of any course based on some level of self-pacing, in particular, those which provide CoD. However, the

[1]By having students submit assignments online and timestamping and applying bonuses and penalties automatically, neither conditional nor absolute deadline contingencies are more difficult to administer. However, the initial coding of the online scripts is slightly more involved for the conditional contingencies.

argument for deadlines will be supported best, if retention test scores are higher for students in groups C and A than for students in group R. The case for deadlines will be stronger still, if data on pacing preference are not significantly different between groups. On the other hand, if students in group C report a significantly higher preference for self-pacing than students in group A, then this would seem to indicate that any additional overhead associated with contingency C may be worth the gain in affective benefit to the student.

1.2 Research Hypotheses

Let $\overline{RT}_g$, $\overline{PT}_g$, $\overline{D}_g$, $\overline{P}_g$, $\overline{R}_g$, and $\overline{PP}_g$ be the average retention test score, posttest score, difference between posttest and retention test scores, procrastination level in terms of days late on assignments, number of requests for special consideration, and pacing preference, respectively, for students in group g, where g is either R, C, or A. To state the research questions under investigation more formally, recommended, conditional, and absolute deadline contingencies as applied to performance-based assignments completed by preservice teachers in a college course on instructional technology will have the following effects on the dependent measures.

- *Achievement scores on a retention test* given one month after the administration of treatments will be higher for students in C and A than for students in R. It should be noted that, due to a lack of research comparing procrastination levels for students with conditional versus absolute deadlines, it is not clear whether students in C will procrastinate more or less than students in A. However, it is anticipated that the students in the group with the lowest procrastination level will perform better on the retention test.

$$\text{If } \overline{P}_c \text{ is lowest, then } \overline{RT}_c > \overline{RT}_a > \overline{RT}_r$$
$$\text{If } \overline{P}_a \text{ is lowest, then } \overline{RT}_a > \overline{RT}_c > \overline{RT}_r$$

- *Achievement scores on a posttest* given immediately after administration of treatments will not differ significantly across treatments.

$$\overline{PT}_r = \overline{PT}_c = \overline{PT}_a$$

The two hypotheses above can really be combined into one hypothesis about the interaction expected between time and treatment. Although all groups should have the same basic understanding of the material at the time the posttest is administered, it is anticipated that the treatment condition will have an effect on the amount students forget during the time interval between administration of the posttest and the retention test, where the amount a student forgets is measured by subtracting the retention test score from the posttest score. It is expected that students in R will forget more than students in C and A. With respect to groups C and A, the group with the lowest procrastination level is expected to forget less.

$$\text{If } \overline{P}_c \text{ is lowest, then } \overline{D}_r > \overline{D}_a > \overline{D}_c$$
$$\text{If } \overline{P}_a \text{ is lowest, then } \overline{D}_r > \overline{D}_c > \overline{D}_a$$

- *Preference for self-pacing* reported by students will not differ significantly across treatments.

$$\overline{PP}_r = \overline{PP}_c = \overline{PP}_a$$

- *Procrastination level* as measured by the average number of days late on assignments per student will be higher for students in R than for students in C and A, while the average number of requests for deadline extensions per student will be lower for students in R.

$$\overline{P}_r > \overline{P}_c, \overline{P}_a$$
$$\overline{R}_r < \overline{R}_c, \overline{R}_a$$

Again, with respect to students in C and A, it is not clear who will procrastinate more or request more extensions. Students in C may procrastinate more than students in A, who receive a more severe penalty. However, students in C may also procrastinate less in an attempt to earn bonus points.

1.3 Delimitations

The authentic context and online submission of assignments both increased the ecological validity of the study. Findings should generalize well to students in other classes, including distant learners. Because the participants were preservice teachers, study outcomes apply to adult learners at best. However, to support generalization to this larger group, future studies should consider other types of adult learners. In particular, one might examine business majors, computer science majors, and/or employees with programming responsibilities. Other age groups should be examined as well.

In this study, the acquisition of a particular computer skill, Internet programming using HTML, was investigated. Although the results should generalize to other computer-related skills, including using applications such as word processors and spreadsheets, and possibly to programming with higher level languages, future research should be conducted to support such generalizations. Also, it would be interesting to see if subjects other than computer programming would benefit from such a model of instruction.

1.4 Limitations

The increase in external validity mentioned in the previous section, obtained by placing the study in a realistic context, impacted the internal validity of the study. The authentic educational setting made it difficult to control for all extraneous variables. However, every attempt was made to ensure that these were kept to a minimum. For example, one of the greatest threats was that students, prior to the treatment interval, might have formed study groups in the ongoing class that they intended to maintain. In that case, students who worked on assignments together would have dependent achievement scores, which would adversely affect data analysis. In order to minimize the impact of such dependence, a survey was administered before the treatment interval asking students to list the students with whom they regularly worked on assignments for the class. All students in a given self-made study group were randomly assigned to the same treatment, and their scores on the achievement measures were averaged to produce a single data point for analysis.

Other attempts to strengthen the study included having each TA administer all three treatments and randomly assigning students to treatments. Also, because the TAs could seriously threaten internal validity if they allowed students in groups C and A to submit assignments for credit after the deadlines, all assignments were submitted electronically and timestamped. The TAs also might have impacted internal validity, if they felt that any of the treatments were unjust and expressed this opinion to their students. In order to lessen TA as well as student concern about any potential advantages for a particular group, both students and TAs were supplied with two important facts. First, they were informed that it was not clear which group might have an advantage in the end[2]. Second, they were told that the scores of students in the disadvantaged group(s) would be raised to eliminate differences.

Students were given this information with the hope that it would reduce any feelings of demoralization caused by assignment to a particular treatment. Providing this information to them was not expected to cause any new problems, because the nature of the treatments and the electronic submission process with automatic

[2]TAs were told that students in groups R and C might earn better assignment scores, but also might perform worse on the posttest and/or retention test, due to higher levels of procrastination.

timestamp did not allow the students to gain access to any treatment other than their own. In addition, had the students not been informed of treatment differences, it was likely that many would have learned about the nature of the different treatments from fellow classmates. Because this information might have been conveyed differently, depending on the source, it seemed advisable to inform all students systematically.

1.5 Acronyms and Definitions

See Table 1 for a listing of common acronyms and Table 2 for a listing of common terms and phrases used in this report.

Table 1. Common Acronyms Used

Acronym	Represents
A	absolute deadlines
ALN	Asynchronous Learning Network
AOL	America Online, Inc.
C	conditional deadlines
CAI	computer aided instruction
CBVT	Competency-Based Vocational Training
CMI	computer managed instruction
CoD	content on demand
EdTech	instructional technology course sampled
FAQ	frequently asked questions
FTF	face to face
HTML	Hypertext Markup Language
MAC	Macintosh computer
MP3	compressed sound file
PC	personal computer
PSI	Personalized System of Instruction
R	recommended deadlines
RDTR	relative digression from a target response
TA	teaching assistant
TC	traditional classroom
TI	traditional instruction
VC	Virtual Classroom
WAV	uncompressed sound file
WYSIWYG	what you see is what you get

Table 2. Common Terms and Phrases

Term or Phrase	Represents
self-paced	no time constraints on course completion
content on demand (CoD)	access to course content anytime, anywhere
deadline contingency	consequence of submitting work early, on time, or late with respect to supplied deadlines
recommended deadline (R)	deadline given to guide the student who wishes to complete all assignments in a timely fashion; not associated with any bonus or penalty points
conditional deadline (C)	deadline by which assignment must be submitted to receive full credit; assignments submitted a set amount (C_b) earlier receive bonus points; assignments submitted late up to a set point (C_p) are partially penalized; assignments are not accepted for credit after C_p
absolute deadline (A)	deadline by which assignment must be submitted to receive any credit
retention achievement	score earned by students on nine multiple choice items and one 12-point essay question covering HTML one month after treatment administration
posttest achievement	score earned by students on 36 multiple choice items and one 48-point essay question covering HTML immediately following treatment administration
pacing preference	self-report of preference for teacher-pacing versus self-pacing on an eight item rating scale with values ranging from one to five
procrastination level	combination of average number of days late in submitting assignments and number of requests for special consideration (i.e., deadline extensions)

Chapter 2

Literature Review

This study drew inspiration and direction from many sources, including self-paced instruction, massed versus distributed or spaced practice, distance learning, tutoring, group lecture and discussion, active learning, cooperative learning, and Asynchronous Learning Networks. All of the research areas discussed below informed the design of the current study, which investigated the effects of assignment deadlines on the immediate achievement, retention of knowledge, satisfaction, and procrastination level of students who were able to access all course content on demand. In addition, the courseware used in the study incorporated active learning modules, supported collaborative learning, and allowed the instructors and course assistants to tutor individual students during office and computer laboratory hours as well as via e-mail.

2.1 Self Pacing

Some would argue that self-paced training dates back to Socrates and his establishment of the Socratic method. In 1915, Sidney L. Pressey designed the first mechanized teaching machine. It “could present material, require a response, and provide reinforcement, as well as administer and score multiple-choice examinations” (Back & McCombs, 1984, p. 4). This development was followed by programmed learning, personalized instruction, and competency-based vocational training.

2.1.1 Programmed Learning

Skinner (1954) initiated the concept of programmed learning when he asserted the need for more frequent and immediate reinforcement in the classroom. He also indicated that in order to accomplish this, the teacher must employ mechanized aid. Early programmed learning strategies made use of workbooks, but many now rely on computers to deliver content. This instructional technique provides the student with small units of information, each of which requires an immediate response from the student. Each response is evaluated and feedback is supplied immediately (Back & McCombs, 1984). Student progress is self-paced.

2.1.2 Keller's Personalized System of Instruction

Another form of self-paced learning, individualized instruction, supplies the learner with activities that are based on individual differences in skill level, cognitive style, aptitude, and background (Back & McCombs, 1984). One popular instance of this teaching strategy is Keller's Personalized System of Instruction (PSI). It was developed in the 1960's and used extensively in the early 1970s. In his own words, Keller describes the key features of PSI as follows (Keller, 1968).

- The go-at-your-own-pace feature, which permits a student to move through the course at a speed commensurate with his ability and other demands upon his time.
- The unit-perfection requirement for advance, which lets the student go ahead to new material only after demonstrating mastery of that which preceded.
- The use of lectures and demonstrations as vehicles of motivation, rather than sources of critical information.
- The related stress upon the written word in teacher-student communication; and, finally:
- The use of proctors, which permits repeated testing, immediate scoring, almost unavoidable tutoring, and a marked enhancement of the personal-social aspect of the educational process.

So the main features include self-pacing, required mastery, motivational presentations, immediate feedback and tutoring, and a fifth element which is better described as providing students with content on demand. In fact, another proponent of PSI restated the fourth item in Keller's list and expanded its coverage to include providing students with "*essential* subject matter...in writing, on tape, on film, by computer, or by any means accessible to the student when *he* is ready for it" (Green, 1974, p. 5).

In a 1979 meta-analysis on PSI, Kulik et. al. found PSI to be superior when compared to traditional instruction (TI) in promoting academic achievement, in producing less variation on achievement outcomes, and in student ratings of college courses. They also found that course completion rates and student workload did not differ significantly between courses delivered using PSI versus TI (Kulik et al., 1979). In particular, they report that final exam scores for PSI courses are about 8 percentage points higher than for TI courses. Retention scores are about 14 percentage points higher. In addition, students "rate PSI classes as more enjoyable, more demanding, and higher in overall quality and contribution to student learning." (Kulik et al., 1979, p. 317) Finally, they indicate that completion rates might actually be higher for PSI courses, because few students complete such courses with D's or F's. It should be noted that this is in direct conflict with Lloyd (1978), who reports that several authors have "amply documented that more students withdrew from Keller courses than from traditional courses" (p. 505). Although one might argue that, if completion rates actually are lower for PSI courses, measures of achievement might be inflated, Kulik, Kulik, and Bangert-Drowns (1990) counterclaim that "superior examination scores are characteristic of PSI classes with elevated, normal, and below-average completion rates....Higher student achievement in PSI classes is not an illusion created by the withdrawal of the weaker students before final-examination time" (p. 286). They base their claim on the results of a meta-analysis on mastery learning, a key component of PSI courses.

Despite the well-documented advantages of the system, its use has declined. PSI was researched heavily in the 1970's and looked quite promising at that time. In fact, Kulik and Kulik (1975) comment on the phenomenal findings of 39 well-constructed studies comparing PSI with TI. They report that 38 found PSI superior with respect to achievement (34 found statistical significance), and that the differences were generally large enough to be considered of practical significance. In their opinion, PSI has "the most impressive record achieved by a teaching method in higher education" (Kulik & Kulik, 1975, p. 230). Still, research and usage of PSI declined in the 1980's (Lamal, 1984; Lloyd & Lloyd, 1986). Problems associated with PSI include student procrastination and corresponding drop-out rates, difficulty fitting it into the current educational setting, keeping grading consistent when assignments are submitted at different times, determining who owns the rights to course materials (intellectual property), and the lack of systematic rewards for instructors who develop PSI courseware (Lloyd & Lloyd, 1986). Many of these same issues are resurfacing today in distance learning environments such as ALNs (Evans, 1995; Hiltz, 1997). Despite these problems, the merits of PSI over traditional methods, along with advances in technology that should make course management and courseware maintenance more feasible (Crosbie & Kelly, 1993), warrant taking a closer look at the system. In fact, with the current shift toward distance education, PSI, in part or in whole, may prove an effective paradigm for distant learners (Murdock, 2000). If it is to succeed, then each of the issues raised above must be addressed systematically.

2.1.3 Competency-Based Vocational Training

Competency-Based Vocational Training (CBVT) is a method of self-paced training used in some industrial and vocational settings. Watson (1990) analyzed three CBVT programs operating in Canada, Minnesota, and Australia. His findings shed light on issues that need to be addressed when using any method of self-paced instruction.

In his overview of CBVT, he points out that it is well-suited for content that can be easily divided into small skills. He also feels it is an appropriate method for industry and college, because student backgrounds vary widely, it promotes good traits such as independence and self-reliance, and it provides the mature student with the options of flexible enrollment and attendance (Watson, 1990). PSI researchers have also noted the advantage of their own self-paced approach in promoting independent scholarship, with students making claims such as " 'If I...don't do well in this course, I have no one to blame but myself' " (Cooper & Greiner, 1971, p. 397).

In site visits conducted in 1988 and 1989, Watson (1990) observed that, while it is relatively easy to list competencies, one drawback of this approach is that it is time consuming and expensive to develop the training packages. Furthermore, while most of the staff were happy with the system, some teachers reported feeling insecure, unsatisfied, powerless, and/or frustrated. The author recommends preparing instructors better and having them participate in ongoing staff development in order to improve morale and motivation. A commitment and belief in the competency-based approach could be fostered by having teachers acquire *competencies* in developing CBVT materials (Watson, 1990).

Students reported that they were very satisfied with the instructional approach, especially with the self-paced aspect. Over the three year period, however, the general level of reported enjoyment declined. This could be due to any number of factors not directly addressed by Watson (1990). For example, perhaps the equipment used to deliver some of the course content was not well-maintained. Also, the author indicates that the quality of course materials tended to decline with time. This might have had a negative effect on student satisfaction. The most frequent complaints made by the students were that staff were not always available for guidance and testing, and that grading was inconsistent. These problems could be alleviated to some extent by the introduction of computer aided instruction (CAI) and management (CMI). In addition, course material needs to be better maintained. Written material should be understandable by most students, and audio-visual material should be coordinated with written material. Watson (1990) also recommends that learners be prepared for the self-paced format, and that principles of self-paced learning be incorporated in the course design. These include using small steps, matching learning activities with objectives, requiring continuous student responding, and providing immediate and regular feedback (Watson, 1990).

2.1.4 Critical Factors for Successful Self-Paced Training

In an extensive literature review, Back and McCombs (1984) found that the inclusion of a combination of factors is essential for successful self-paced training. Careful consideration of instructional factors ensures that a good match is made between content delivery and student needs. Careful consideration of managerial needs fosters a high level of instructor dedication and motivation. When the needs of students and instructors are met, then self-paced training is considered cost effective with respect to money and the quality of graduates produced, and hence, a success (Back & McCombs, 1984).

Specifically, Back and McCombs (1984) found that the following instructional factors were present in the literature describing successful self-pacing.

- delivery method matched current knowledge and performance levels as well as field requirements
- continual Instructional Systems Development process employed
- quality instructional materials, with an adequate mix of media
- student-student interactions via team and group activities
- student-instructor interactions

The following managerial factors were also present.

- strong management support
- flexible implementation approach that is easily adapted to current needs
- effective scheduling of limited equipment
- staff involvement and participatory management
- adequate staff and instructor training
- well defined instructor roles

Back and McCombs (1984) also found that adequate self-paced instruction "requires a complete task analysis, specification of goals and objectives,...and performance-based evaluation" (Back & McCombs, 1984, p. 43). Care should also be taken to prepare students for the self-paced format and the self-responsibility it demands as well as to match instruction to learning styles. Student-student and student-instructor interactions establish a forum where students can get needed encouragement, feedback on progress, and have a chance to discuss problems. Finally, "in-house personnel [including instructors] should be involved in decision making and curriculum development" (Back & McCombs, 1984, p. 43). In addition to increasing feelings of satisfaction, such teamwork should have the added benefit of helping to distribute the task of developing all of the instructional material for a course that might overwhelm a single instructor working alone (Smith, 1974).

2.1.5 Disadvantages of the Self-Paced Approach

Even though self-paced training seems to offer a number of benefits, its adoption is hindered by several inherent flaws. First, student procrastination is a major problem (Rae, 1993). Second, this approach does not fit easily into the current educational structure. In 1981, Keller stated that he feared reform would come slowly. In his words, the "outlook is not good for any system of instruction that threatens to change the length of a classroom hour; the duration of a course; the shape of a grade distribution; the policies of admission; the practices of registration and record keeping; the integrity of the Class of '84; or any of the everyday routines of teachers, administrative officers, supporting staff, or even students" (Keller, 1981, p. 38). Also, as mentioned earlier, tracking individual student progress, keeping grading consistent, and maintaining quality instructional materials is challenging.

2.1.6 Curbing Procrastination with Deadline Contingencies

Many researchers have considered the issue of procrastination and how it might be reduced or even eliminated. A number of strategies have been employed and include giving students bonus points for completing work early (Powers, Edwards, & Hoehle, 1973; Bufford, 1976; Lu, 1976; Lloyd & Zylla, 1981; Reiser, 1984; Lamwers & Jazwinski, 1989), deducting penalty points for submitting work late (Reiser, 1984; Ross & McBean, 1995), applying both bonus points and penalty points in conjunction (Morris et al., 1978; Welsh, Malott, & Kent, 1980; Crosbie & Kelly, 1993), losing all points for late work (Cooper & Greiner, 1971; Robin & Graham, 1974), requiring additional work (Murdock, 2000), having instructor-set deadlines for some or all tests (i.e., midterm, review tests, unit tests) (Lloyd, 1978; Glick & Semb, 1978b; Hobbs, 1981), scheduling an early final for students who finish all work early (Lloyd, 1978), frequent testing (Mawhinney, Bostow, Laws, Blumenfeld,

& Hopkins, 1971; Wesp & Ford, 1982; Wesp, 1986), requiring students to withdraw when too many deadlines are missed (Miller, Weaver, & Semb, 1974; Roberts & Semb, 1980; Lamwers & Jazwinski, 1989), supplying students with target deadlines which must be met to earn a particular course letter grade (Reiser, 1977), a single early instructor-imposed deadline (Sweeney, Butler, & Rosen, 1979), verbal reinforcement from proctors (Lu, 1976), allowing students to set their own deadlines (Welsh et al., 1980; Lloyd & Zylla, 1981; Roberts, Fulton, & Semb, 1988; Roberts & Semb, 1990), giving students the choice between student-set and instructor-set deadlines (Roberts & Semb, 1989), and allowing students to set up deadline contracts jointly with the instructor (Lamwers & Jazwinski, 1989).

Most studies have yielded results indicating that the use of deadline contingencies is an effective method of reducing procrastination without jeopardizing achievement (Glick & Semb, 1978a, 1978b; Roberts et al., 1988; Roberts & Semb, 1989, 1990; Wesp & Ford, 1982; Ross & McBean, 1995; Wesp, 1986; Reiser, 1977). In fact, only two of the studies reviewed reported finding a significant difference between treatments on achievement measures given immediately following treatment intervals. In one case, the student-paced group performed better (Powers et al., 1973). In the other, the instructor-paced group had superior performance (Hobbs, 1981). In both cases, there were potentially confounding variables. In a study conducted by Powers et al. (1973), students received bonus points in one treatment, but not in the other. Students who did not receive bonus points likely were more motivated to do well on the final, and in fact, they did perform significantly better. In the other study, students in the completely self-paced treatment were allowed to retest for mastery up to three times, while students in the group with instructor-imposed deadlines were not allowed to retake unit tests (Hobbs, 1981). In addition, students in the latter group took half as many tests which each covered twice as much material. It is quite likely that grades in the completely self-paced group were higher, because students were tested on less material each time and were able to retake unit tests. Hence, they likely were less motivated to perform well on the final, which they were told could only improve their grade and not lower it.

The limited number of researchers who have reported data on course ratings by students under different deadline contingencies have generally found no significant difference in level of self-reported satisfaction with the course (Hobbs, 1981; Reiser, 1977; Robin & Graham, 1974). In one case (Hobbs, 1981), however, the treatment conditions were confounded by the inclusion of mastery in the self-paced treatment and not in the instructor-paced treatment. In another study (Reiser, 1977), the contingency was a drop in letter grade, if the instructor-set deadlines were not met. In another (Robin & Graham, 1974), deadlines were absolute for the teacher-paced group. Satisfaction has not been reported for all of the different contingencies that have been investigated, and so, more evidence is needed to ensure that the various alternatives of instructor-pacing do not adversely affect student satisfaction. Interestingly, some researchers have suggested that satisfaction may be affected by the way the contingency is described (Murdock, 2000; Robin & Graham, 1974). Murdock (2000) provided two groups with the same contingencies, in one case describing them in terms of remediation and in the other describing them in terms of enhancing mastery. His study "showed that describing the contingency regarding its potential learning benefits generated more positive student ratings, and less reports of anxiety, than when the contingency was described as a penalty" (Murdock, 2000, p. 151).

Because deadline contingencies effectively reduce procrastination without detriment to achievement, and based on available evidence, need not adversely affect student satisfaction, they appear to be an important component to include in any PSI course and possibly any course incorporating some level of self-pacing, including courses which provide CoD. Many of the contingencies researched require substantial administrative overhead. Because all seem to be effective in reducing procrastination without detriment to achievement and possibly satisfaction, it would seem advisable to select one which requires minimal effort to implement, such as enforcing one early deadline or awarding bonus and/or penalty points depending on when assignments are submitted relative to due dates. Again, more research is needed to determine the effects of the selected contingencies on student satisfaction.

2.1.7 Mitigating Disadvantages with CAI and Video

Several of the problems associated with self-pacing can be lessened by introducing computer aided instruction (CAI) and management. For example, if designed with flexibility in mind, a computer program can allow new learning modules to be incorporated into it without the costly need to reformat and reprint paper packets. Courseware delivered online is also quite easy to update and no paper packets ever need to be printed. Students can view and print (if desired) the most up to date information at any time. Also, students would not have to schedule time with staff for testing. This could be accomplished via the computer. Likewise, inconsistent grading could be reduced or eliminated via automation. Automated grading would also allow the instructor to deal effectively with the increased grading load and resulting bottleneck imposed by the need to evaluate competencies for each student on a larger number of small activities. Furthermore, the automated grading could be used to provide formative evaluation to the student that would help focus his or her questions during sessions with the instructor and/or aids.

Flexible CAI would allow individual teachers to easily incorporate their own learning modules into the system. This would satisfy two goals. First, each instructor would feel that s/he plays an integral part in the process and that his or her input is valued. Second, the students would have a variety of resources from which to draw. For example, say that several instructors contribute short video clips of lectures on the same topic. Then, if a student does not understand how one instructor describes a concept, s/he can listen to another instructor's discourse. Otherwise, the student can progress to new material. Another advantage of video clips is that the student can review the lecture over and over until s/he understands – a task difficult to accomplish with a live lecturer.

Rae (1993) reports that, in his course on discrete mathematics, "the use of video and computer-delivered instruction enables the use of fewer and less well-qualified tutors....Discounting the cost of the videos and [CAI],...the course is actually cheaper to run than if it were taught conventionally" (Rae, 1993, p. 44). Furthermore, the incorporation of video allows for a personal element often lacking in CAI alone. When Rae first introduced the videos to his course, he claims that the effects on student performance were dramatic and were reflected in high examination marks. Also, 75% of the students reported on a survey that the videos were "helpful" or "very helpful", while less than 60% reported the same feelings about the course CAI alone (Rae, 1993). Another team of researchers reports that using computers to automate testing made it possible to effectively run a PSI course for 51 students "without the five proctors that would normally be required" (Crosbie & Kelly, 1993, p. 366).

2.2 Massed, Distributed, and Spaced Practice

The literature on massed, distributed, and spaced practice has focused mainly on the practice of nonfunctional tasks and motor skills (Mulligan, Guess, Holvoet, & Brown, 1980; Grote, 1995). Although the "superiority of distributed practice over massed practice has been well documented in psychological literature for about 100 years,...the bulk of the research in this area...occurred in laboratory settings" (Grote, 1995, p. 97). However, a few researchers have explored its implications in the classroom for learning and retention of more complex information like Physics topics (Grote, 1992, 1995), Astronomy topics (Lu, 1978), and French vocabulary (Bloom & Shuell, 1981). Massed, distributed, and spaced practice are distinguished from one another in terms of the intervals between training trials. In massed practice, the duration of the interval is negligible. In spaced practice, the time between trials is used for rest. In distributed practice, it is used to practice different material. Distributed practice is most like the typical experiences of a student. Trials take place during class, study time, and while completing assignments. The time between trials is devoted to other tasks.

Research indicates that "skills taught with a spaced or distributed trial sequence are learned better than skills learned using massed trials" (Mulligan et al., 1980, p. 328). Of the studies reviewed where researchers considered the immediate acquisition and/or retention of complex information in a classroom setting, one investigated only immediate acquisition and found a significant difference in favor of distributed practice (Lu, 1978), two investigated only retention and found a significant difference in favor of distributed practice (Grote, 1992, 1995), and one investigated both, finding no significant difference in immediate acquisition but significantly higher retention rates for students who engaged in distributed practice (Bloom & Shuell, 1981). Clearly, more evidence is needed before any definitive statements can be made about the merits of distributed practice over massed practice in an authentic setting. However, a closer inspection of the four studies reviewed indicates that the findings of Bloom and Shuell (1981) are strongest.

The study by Lu (1978) equates the hierarchical presentation of concepts in which "preceding ideas are integrated within each new idea as it is presented" (p. 254) with distributed practice and the use of "advance organizers" and "delay organizers" with massed practice. In all three treatments considered, students were presented with approximately 13 minute audio lessons covering the material, followed by a 12 minute free-recall test where students were asked to record as many facts as they could remember. They were told about the free-recall test prior to hearing the audio lessons. One group was given an initial overview of the material first, another was given a summary of the material afterwards, and the third was told how concepts related to one another as they were discussed. These treatment conditions do not represent instantiations of massed versus distributed practice as clearly as the other three studies do.

The two reports by Grote (1992, 1995) described studies that were similar in nature. In each case, students were divided into two groups. Both groups were given classroom instruction on two Physics topics, call them topics A and B. The following day, one group practiced all study questions for topic A, while the other group practiced all study questions for topic B. Then the groups switched topics, and over the next several weeks, each group practiced only a few study questions a day until it had studied all of the same questions that the other group had studied en masse. After all practice was complete, the author waited between two weeks and two months, depending on the particular study, before giving a retention test on both topics. In all cases, the material that was learned via distributed practice was best remembered. Unfortunately, due to the fact that the massed practice treatment always occurred before the distributed practice treatment, the retention interval was always longer for the material learned en masse. During the three to four week interval it took students to complete the distributed practice phase of the study, they likely were forgetting what they had learned during the massed practice phase of the study. In addition, although the author does not indicate whether or not the students were informed about the upcoming retention tests, it is likely that they were informed, because the study was conducted as part of an actual class. If that is the case, then students would have had the opportunity to study for the exam, and in essence, to learn or relearn the material.

As mentioned before, the study conducted by Bloom and Shuell (1981) offers the strongest evidence, indicating that massed and distributed practice yield comparable initial results with respect to learning, but that memory is enhanced under conditions of distributed practice. Fifty-six French students were stratified according to previous performance and randomly assigned to one of two groups. Both groups learned 20 vocabulary words and were told they would be tested on the material after practicing it. One group practiced the words during three 10 minute sessions conducted on three consecutive days, while the other group practiced them during one 30 minute session. The last 10 minutes of the massed practice session coincided with the last 10 minute session completed by the distributed practice group. All students were tested immediately after the final practice session. No significant difference was found between groups. However, in an unannounced test given four days later, students in the distributed practice group had significantly better recall of the French words. The nature of this study better reflects what might be expected in an actual classroom, where some students study the material throughout the course, while others cram for exams at the end of the course. That fact, along with the fact that the retention test was unannounced, so that students did not have a chance to review the material, provides strong evidence that, while distributed practice might show no advantage on immediate measures of achievement, it might show an advantage on later retention of the material. The authors explicitly point out the importance of measuring retention when calculating the benefits of distributed practice.

The findings of Bloom and Shuell (1981) actually may explain why little difference in achievement has been documented when using deadlines to reduce procrastination. Lower levels of procrastination should correspond with a more distributed learning approach, in which case a difference in achievement may be indicated on a retention test. Such issues are critical for evaluating the need for deadlines in a course with some level of self-pacing. After all, if "students cannot remember what they have learned, they might as well not have learned it in the first place" (Bloom & Shuell, 1981, p. 247).

Although a number of researchers have investigated disparities between the retention scores of students in courses taught using PSI versus TI, which differ from one another along important dimensions in addition to pacing, few have considered the effect of various deadline contingencies on retention for groups which are all exposed to PSI. Of those who have, one team found no difference in retention test scores (Robin & Graham, 1974), while another found relatively weak evidence of an interaction between time and treatment ($F(2,45)$, $p = .094$, $\hat{f} = .31$) with the trend over time indicating a possible advantage for the self-paced group (Morris et al., 1978). However, the findings of both of these studies should be interpreted with caution.

In the study conducted by Robin and Graham (1974), volunteers were recruited from a lecture section, with under 20 assigned to each treatment after participants dropped out. Some evidence indicates that the larger number who dropped out of the teacher-paced group may have done so because of the contingency, but no descriptive data are supplied to enable the comparison of dropouts across treatments. Furthermore, students had advance knowledge of the retention test, which was given after only three weeks, those who completed unit tests early experienced a longer retention interval, the posttest and retention test both had a low mastery criterion of 50%, and for many students, these exams had no effect on their final grades. Finally, although submission rates appeared to be slightly more uniform for students in the teacher-paced group, according to a visual inspection of their individual cumulative submission records, analysis of the rate of first takes and the quarter-life[1] for students on average did not provide strong evidence that the groups differed significantly in response rate, or in other words, in level of procrastination.

Complications in the study conducted by Morris et al. (1978) also make their findings difficult to interpret. Students were informed that none of the achievement measures would affect their grade, the posttest and retention test were announced, less than 43% of the students volunteered to return nine months later and take the retention test, no statistics were supplied to support the claim that the volunteer subsets for each treatment adequately represented the original treatment sets with respect to posttest and final grade distributions, and the degrees of freedom for the error term appears to have been misreported[2] as 98 rather than 45, possibly inflating the calculated F value with respect to the critical F value. Obviously, more research is needed to determine if deadline contingencies can be used in a course with some level of self-pacing in order to reduce procrastination by forcing a more distributed pattern of practice, and ultimately, to increase student retention of content. The current study attempts to bring together these two lines of research and to find evidence that will inform the use of deadline contingencies in courses which supply CoD.

[1] Robin and Graham (1974) calculated the rate of first takes for an individual student by dividing the total number of unit exams attempted at least once by the time interval over which the attempts were made. They calculated the quarter-life by dividing the length of time it took the student to complete one quarter of the first takes by the total time interval over which first attempts were made.

[2] Morris et al. (1978) indicated that 51 students took the retention test. Because they considered two treatment conditions, a pretest, a posttest, and a retention test in their analysis, the degrees of freedom for the error term should be $51 - (2 \times 3) = 45$.

2.3 Distance Education Via Asynchronous Learning Networks

As mentioned earlier, ALNs support collaborative learning and self-pacing. Andriole, et. al. used an instantiation of the system to teach college students at Drexel University software systems design and reported two of the main benefits to be the ALN's accommodation of self-pacing and its cost-effectiveness. They felt it was cost-effective, because the system could be implemented using off-the-shelf hardware and software. Also, as the number of students increased, it was estimated that the cost of instructors would be less, because cheaper ALN assistants could be employed to handle the extra load. In the vein of competency-based training, they recommend developing a lesson for an ALN course by first deciding on desired knowledge and skill outcomes, next converting these into topics, subtopics, and assignments, and finally, matching course readings with the topics (Andriole, Lytle, & Monsanto, 1995).

In agreement with the literature on self-pacing, Andriole et. al. point out that for an ALN to be successful, structure is important. There must be a clear and predictable schedule and "real-time monitoring of student performance" (Andriole et al., 1995, p. 101). They add that all materials must be online, the course should have a common "look and feel", and that online discussions should be introduced and concluded with "opening and closing discussion windows" (Andriole et al., 1995, p. 101). Furthermore, students should be able to learn ALN software in 2 hours or less, to communicate with instructors and fellow students publicly and privately, to see the work of other students and examples of good assignments, and to post questions (Andriole et al., 1995).

Again, in agreement with other research on self-pacing, student responses to surveys given at the end of their ALN courses reveal high student satisfaction with the system. For example, 80% found conventional courses more boring than ALN courses and say they will take another ALN course. Also, 75% did not miss lectures and 70% felt they learned more than they would have expected to learn in a conventional course. In addition, 85% felt they had more access to the instructor, 75% felt there was more student-student communication, and 95% felt it was useful to see other students' work and assignments. Another contributing factor to the success of their ALN is likely the fact that they employed databases to manage class discussions, course materials, assignment descriptions, and instructor/student diaries (Andriole et al., 1995).

Although data indicate that their ALN is successful, the authors still fear that ALNs may not be universally accepted. They believe that "not all faculty or institutions can – or will want to –" (p. 101) switch to an ALN, which is based so heavily on self-pacing. Also, initially preparing material for an ALN course is very time consuming, and unless the instructor is allotted extra time for these endeavors, s/he will be less likely to choose to commit the overload time needed. They state that, while they feel ALNs are an advantageous instructional and management strategy, the "danger today is that asynchronous learning – along with other forms of 'distance education' – will remain in the labs and in the hands of techno-educators – [those] who seldom represent the mainstream faculty interests" (Andriole et al., 1995, p. 101).

The New Jersey Institute of Technology is also looking into the use of ALNs. Their system, called the Virtual Classroom (VC), is used to enrich on-campus courses where most class interactions are face to face (FTF) and to support distance learning environments that utilize minimal FTF encounters. Lectures are delivered via audio and video channels and conferencing is text-based. The system supports collaborative learning, self-pacing, and individualized instruction. Software structures are in place that promote effective collaboration between students and faculty by ordering transcripts of discussions and forcing active participation. Collaborative techniques employed in the VC include "seminar" type exchanges, debates, group projects, case study discussions, simulation and role-playing, sharing of homework solutions, and collaborative composition. Also, students are asked to identify key skills and concepts, make up questions based on those, and then share them with each other and attempt to answer them.

In the VC, content is tailored to the individual in the sense that unique topics are assigned and the equivalent of content bookmarks are maintained for each student. Also, an electronic grade book is in place. The VC's support of self-pacing gives students more time to reflect before engaging in discussions, makes it easier to fit school into their busy lives, and mitigates possible frustration, because they are not forced to progress through the material at a rate that is too fast or too slow for their abilities (Hiltz, 1997).

Two complete degrees, the B.A. in Information Sciences and the B.S. in Computer Science, are offered using a mixture of video and the VC. Hiltz, in examining outcomes for the Information Sciences programs, reports that mastery in the VC is equal or superior to mastery in the traditional classroom (TC). Also, VC students report higher course satisfaction. In addition, VC students who collaborate are "most likely to judge the outcomes of online courses to be superior to the outcomes of traditional courses" (Hiltz, 1997).

Findings are based on pre- and post-course questionnaires, direct observations of online activities, interviews with selected students, tests, course grades, and faculty reports. Hiltz acknowledges that "self-report data from questionnaires suffers from some validity issues" (Hiltz, 1997). To mitigate such effects, confidentiality was guaranteed and measures were taken to reassure the students of this fact. Responses of students taking the same course with the same teacher were compared. Sections that incorporated the VC were compared to sections that did not (TC). Students utilizing the VC were also asked to compare their current experiences with experiences in past, more traditional courses.

Students in the VC reported the following problems. Thirteen percent had serious PC-related problems and 40%-50% had serious problems when dialing in due to receiving a busy signal. In addition, VC students reported that they developed fewer new friendships in class, and that they were more likely to stop "attending class". Procrastination was also a problem (Hiltz, 1997).

On the other hand, VC students were more likely to feel they had participated actively in discussions, to rate the course highly, and were less likely to report that the class was a waste of time. When asked to compare their current VC experience with previous TC experiences, 71% reported that they felt they had better access to their VC instructor. This was dependent on the fact that the instructor was available online at least once per day. Sixty-nine percent found the VC more convenient, 55% were motivated to work harder, because fellow students would see their work, and 66% found seeing others' work beneficial. Fifty-eight percent disagree with the statement that they would not take another VC course. While 40% felt they learned more in the VC, only 21% disagreed with that feeling. While 20% disagreed with the assertion that the VC increased the quality of their educational experience, 58% concurred that it did (Hiltz, 1997).

Overall, ratings of ALN based courses are equal or superior to traditional courses. Student performance in an ALN environment is generally equal to or better than performance in a TC setting. In the courses considered, 50% of the VC students earned an 'A' or a 'B' as compared to 31% of the TC students. However, ALN dropout rates and incomplete outcomes are generally higher than in TC. Also, more initial course time is required to work out course logistics. Furthermore, quality ALN is more expensive, but costs can be cut by adopting a differentiated staffing model and having TAs perform some of the instructional duties (Hiltz, 1997).

Hiltz also discusses some important issues raised by faculty. First, the videos used by many of the courses are time consuming to produce, taking vast amounts of time to prepare, rehearse, tape, and review. Also, distribution is either a logistical challenge for the teacher who is shipping them or the student who is recording them. In the future, digitized video modules distributed on a CD-ROM or the Internet will likely be explored. Second, the VC creates the need for a new instructor role in coordinating interactions. Faculty need to be trained and supported in acquiring necessary new skills. Third, grading is also a logistical problem, because assignments arrive at different times and days. It's harder for the teacher to keep grading consistent when assignments are not batch processed. Fourth, work load is directly proportional to the number of students. Four students will likely post twice as many questions electronically as two. Faculty need to be supported as the number of VC students increases. Finally, there is the issue of intellectual property. Who owns the rights to the videotapes and ALN materials produced by the instructor? Also, how is the teacher compensated for this extra work? At the very least, an instructor should enjoy a reduced course load during any semester in which s/he is converting a course to an ALN. Also, there should be clear policies of rewarding such efforts when considering promotion and tenure (Hiltz, 1997).

Looking to the future, Hiltz expects that ALNs will increase competition among schools, that there will likely be less schools and more adjuncts. She predicts that universities will be transformed from places young people go to finish growing up into "centers for a variety of degree programs designed to support students of all ages" (Hiltz, 1997). Despite the many advantages of the ALNs, there are still some substantial disadvantages that may hinder their chances of being widely accepted. Most notably, they do not fit easily into the current education system, initial preparation of materials such as video is time consuming, it is hard to maintain consistent grading, students seem less closely connected in that they make fewer new social bonds, students tend to procrastinate, and higher rates of incomplete outcomes and drop outs are recorded. Many of these problems are consistent with well-documented disadvantages reported in the literature on self-paced training.

2.4 Other Teaching Paradigms

As mentioned, the design of the courseware was inspired by work in several areas. Whenever possible, the best features of several instructional paradigms were built in and/or supported. For example, because all content is delivered via the courseware on demand, instructor-student interactions are generally one-on-one. Content is organized and presented concisely in the form of narrated visuals. These are kept short, because research indicates the attention of the passive listener wanes quickly. Lessons are also active and separated from one another by assignments in which students apply immediately the knowledge they have just gained. Finally, while student collaboration is not directly supported by the courseware, it is permitted and encouraged.

2.4.1 Tutoring

One of the strengths of self-paced training is that it can foster the growth of a "relationship between each student and an individual tutor" (Rae, 1993, p. 48). The tutor might be the teacher or another student in the class. Rae found that such a relationship developed with about two-thirds of the students. These relationships were all one-on-one and "initiated by the students' own work" (Rae, 1993, p. 48).

Lepper, Woolverton, and Mumme (1993) assert that the use of tutors is an effective teaching strategy and that the quality of CAI itself can be enhanced by basing design on the practices of expert human tutors. The authors studied such tutors in order to determine effective techniques of one-on-one instruction. Their ultimate goal was to outline the elements that should be considered in the design of computer-based tutors. Expert tutors were selected from four groups of tutors. One group taught second grade students how to carry when adding. One group taught 3rd and 4th graders complex word problems. Two more groups worked with 4th, 5th, and 6th graders on one of two computer drills – “The Factory” or “Darts”. The expert tutors were selected based on “objective learning measures and independent ratings of tutors’ overall effectiveness” (Lepper et al., 1993, p. 77).

The authors feel that current computer tutors approach the task of training with the assumption that the learner is already motivated and attentive. Cognitive issues are often addressed, while affective and motivational issues are not considered. For example, computer tutors generally determine, from a cognitive perspective alone, what information the student needs in order to clarify a misconception. This determination is often made by applying an algorithm to incorrect answers given or actions taken by the student. The student is then informed of his/her lack of understanding directly and told what answer or action was expected. Sometimes, depending on the student’s affective state, s/he requires different, perhaps less direct, feedback (Lepper et al., 1993).

Based on their observations of expert human tutors and on interviews with the tutors following their tutoring sessions, the authors believe that a consideration of cognitive, affective, and motivational issues is essential for successful tutoring. Specifically, in addition to cognitive considerations, the human tutors focus their attention on bolstering self-confidence, maintaining challenge, evoking curiosity, and promoting feelings of control (Lepper et al., 1993). These are all strong motivational factors, as is highlighting the relevance of topics of study to real world situations (Alessi & Trollip, 1991).

Tutors enhance the sense of challenge by modulating objective task difficulty as well as subjective task difficulty. Tutors modify objective task difficulty by giving easier to harder problems based on student understanding, by providing scaffolding (intervening to correct steps), decreasing the size of steps to success, and by increasing or decreasing the specificity of hints. They modify subjective task difficulty by emphasizing the difficulty of the problem, challenging the student directly, and engaging in playful competition (Lepper et al., 1993).

Effective tutors bolster self-confidence by maximizing success and minimizing failure. They maximize success directly with praise and expressions of confidence and indirectly by emphasizing problem difficulty, student agency, and engaging in playful competition. They minimize failure directly with reassurance and commiseration and by redefining success as partial success. They minimize it indirectly by emphasizing problem difficulty, making excuses for the student, and asking questions and providing hints rather than labeling an answer incorrect (Lepper et al., 1993).

Although expert human tutors are able to effectively determine the combined affective, cognitive, and motivational state of their students, this task may prove quite difficult for a computer. If it is even possible, the computer will have to base its appraisal on subtle cues similar to those detected by the human tutors – facial expressions, slowing of response times, etc. Also, based on the study by Lepper et al. (1993), it is not clear which of the many tutor practices identified are the most important, or even clearly beneficial. In fact, some may have negative side effects that are counterbalanced by the positive effects of others. Furthermore, when depending on the use of human tutors, it is unlikely that they will all be experts. Some may actually foster an unhealthy dependence on the part of the student. Fortunately, human tutors can be trained to be more effective by discussing tutorial scenarios like those presented by Coldeway and Schiller (1974) to PSI proctors in their seminar.

2.4.2 Group Lecture and Discussion

Bonwell and Eison state that, given the assumption that the lecturer is knowledgeable and enthusiastic, the lecture method has some advantages. A good lecturer can be a scholarly role model, can present new material that is not yet published, can communicate the intrinsic value of the subject matter in a fashion different from other forms of media, can organize the presentation to meet students' needs, and can communicate a large amount of information efficiently. Furthermore, lectures are generally considered cost-effective, because they are delivered to many students at once. They also provide minimal threat to the student, because s/he is not required to actively participate. Students who enjoy learning by listening may best be served by this teaching strategy (Bonwell & Eison, 1991).

There are, however, substantial disadvantages to using the lecture method. It is difficult for most students to listen effectively to a lecturer for sustained periods of time. In one study, the percentage of content recorded by students was analyzed. During the first 15 minutes, students' notes reflected 41% of the content delivered. During a 30 minute period, only 25% of the content was recorded. During 45 minutes, only 20% was recorded. Other studies show that very little of the content delivered via the lecture method can be recalled by students, unless they have above average intelligence and education (Bonwell & Eison, 1991).

In an analysis of 58 studies reported between the years of 1928 and 1967, lectures and discussions were compared. Although no significant difference was found between the abilities of these two methods to impart the facts and principles, discussions were superior in helping students build their problem solving skills. The discussion format was also preferred by the students. Thus, it would appear that the lengthy lecture is, in fact, an inefficient delivery method that is not preferred by most students (Bonwell & Eison, 1991).

Still, it is a popular method employed by instructors. Studies indicate that lecturing was the main teaching strategy used in the recent past. In one survey (1980) of faculty on 24 campuses, between 73% and 83% of the respondents stated that lecturing was their primary method of teaching. In another (1987), between 61% and 89% of U.S. university professors reported that they used the lecture method (61% in humanities, 81% in social sciences, and 89% in physical sciences and mathematics) (Bonwell & Eison, 1991).

A more recent survey by McEwen (1996) shows an apparent trend toward using alternative teaching methods to teach software skills to business students. This finding is based on the responses of 167 business educators in five Midwestern states teaching at all educational levels (two-thirds at the high school level), 79% of whom had more than 20 years of teaching experience. Respondents reported that, when teaching computer applications, the most effective instructors make use of demonstrations, simulations, and self-paced learning.

2.4.3 Active Learning

Bonwell and Eison define active learning as anything that "involves students in doing things and thinking about the things they are doing" (Bonwell & Eison, 1991, p. 2). They describe classroom activities as existing somewhere along a continuum between passive and active learning. Common characteristics of active learning strategies found in the literature include the following.

- Students do more than just listen (i.e., read, write, discuss).
- There is less emphasis on simply transmitting information.
- There is more emphasis on developing students' skills and on exploration of personal attitudes and values.
- Higher order thinking is stimulated (i.e., analysis, synthesis, evaluation).

Although research shows that active learning is comparable to lecturing in promoting mastery of content, it is superior to lecturing in promoting the development of student skills such as thinking and writing (Bonwell & Eison, 1991). Such thinking and problem-solving skills are essential in many science courses. Furthermore, in several studies, students have reported that they prefer active learning strategies, and cognitive studies reveal that the learning styles of a significant number of students are best served by learning methods other than lecturing (Bonwell & Eison, 1991).

2.4.4 Collaborative and Cooperative Learning

Collaborative environments offer several advantages over the traditional lecture format. As mentioned above, discussions were shown to be superior in promoting problem solving skills and were preferred by students (Bonwell & Eison, 1991). In addition, in a collaborative environment, content is viewed from many perspectives, learners are motivated by the presence of others who are struggling to master the same material, and the trepidation often associated with learning skills that require higher order thinking is mitigated (Preece et al., 1994). In a discussion, both receiving and transmitting students benefit from self explanation in that one receives a needed explanation, while the other deepens his or her understanding by verbalizing and synthesizing ideas together. Students also benefit from appropriation when they learn by watching a more skilled classmate work. Apprenticeship is one form of appropriation. Finally, students are able to internalize information when "verbalizing [it] in a conversation" (Hiltz, 1997). Although collaborative environments have several advantages, one disadvantage is that one learner in a group may completely dominate it and be the only one to benefit (Preece et al., 1994). Also, it is difficult to know which students actually contributed to collaborative projects in substantive ways, making it difficult to assign individuals grades.

Recall that ALNs foster collaboration. They do this by providing "asynchronous access to remote learning resources" (Mayadas, 1994), including peers and experts such as tutors and faculty as well as libraries, software generated simulations, laboratories at a distance, and work products created by remote collaborators. According to Mayadas, the Program Officer of the Sloan Foundation, a major goal of ALNs is to de-emphasize lectures, while emphasizing interaction. The "key components of ALN technology...exist mainly to link people to other people, and to provide a framework for their interaction" (Mayadas, 1994).

2.5 Summary

The design of both the study and the courseware were informed by the literature discussed above. In designing the courseware, an attempt was made to include all factors identified in the literature as critical for successful self-pacing that could feasibly be included at this time. For example, TAs were shown how to navigate through the courseware and how to use the grading rubrics for the assignments. An introductory section of the courseware told students how to navigate through the courseware and advised them of alternative methods of progressing through the content. The courseware was supplied to students on CD-ROM, which should have been reasonable for the population investigated, as students were enrolled in a course to acquire computer skills and to learn about applying educational technology. Student-student and student-teacher communications were encouraged explicitly, and a form for e-mailing questions directly to the TAs as well as links to their Web sites were provided in the courseware. TAs supplied feedback to students on a weekly basis as they graded assignments that were due each week. In addition, TAs did not need to devote time to delivering course content, and instead, were able to use their time tutoring students and addressing their cognitive, affective, and motivational needs. Both audio and visual elements were utilized, and users were supplied with an easy method of providing feedback. The courseware was programmed with modularity in mind, making it relatively easy to add new lessons and to change assignments to meet future course needs. Finally, lessons were kept short and active, they were based on a task analysis of the target product, and assignments were considered relevant, guiding each student through the process of developing a personal Web site.

The study itself was informed by reports on self-pacing, distance learning, the use of deadline contingencies, and the short term and long term effects of massed versus distributed practice. New distance learning paradigms such as ALNs are pushing education to become more learner-centered and to incorporate such elements as self-pacing. Although, self-pacing has been associated with clear advantages with respect to academic achievement and learner satisfaction, it also has the well-documented disadvantage that students tend to procrastinate. Research shows that procrastination can be curbed by using deadline contingencies without detriment to achievement or satisfaction. An added bonus may be enhanced content retention for learners who do not procrastinate. It is hypothesized that the current investigation will replicate the findings of other researchers with respect to immediate achievement, satisfaction, and procrastination level. It is further hypothesized that reducing procrastination by using deadline contingencies will increase retention scores. Such an outcome would support the theory that students who procrastinate less and space learning out over a longer period of time have better recall of the information learned.

Chapter 3

Method

Students from an undergraduate class in instructional technology at a large, southeastern university were randomly assigned to one of three groups. Henceforth, the class will be referred to as EdTech. Although all students were given the same set of eight assignment deadlines, the consequences for not meeting these deadlines differed by group. Students with recommended deadlines (R) were encouraged, but not required, to meet them. However, they were required to submit all work by the final assignment deadline, as no work was accepted for credit from any group after that deadline. Students with conditional deadlines (C) received bonus points for submitting assignments early and lost points for submitting them late. Students with absolute deadlines (A) received no credit for assignments submitted after the posted deadlines.

Courseware on HTML was supplied to each student on a CD-ROM at the start of the study. Each student received one of three student versions of the courseware. Each version contained lessons, assignments, and reference material on HTML. The only difference between versions was the specified deadline contingency. Students were reassured that if there was a significant difference between groups, the scores of students in the disadvantaged group(s) would be adjusted.

Pretest, posttest, and retention test data were to be analyzed using repeated measures, but a randomization model was adopted later due to the abnormal nature of the data. It was anticipated that no significant difference would be found between any of the groups on the pretest and the posttest. However, students in groups C and A were expected to perform significantly better on the retention test than students in group R. Thus, a significant interaction between time (posttest to retention test) and treatment was expected. Pacing preference data collected with the posttest were analyzed using ANOVA. No significant difference was expected between groups. Data on student procrastination were collected in terms of when assignments were submitted relative to due dates and the number of requests for deadline extensions. Although these data were to be analyzed using MANOVA, with the expectation that students in groups C and A would request significantly more deadline extensions, while students in group R would submit assignments significantly later, the number of requests was too sparse to justify MANOVA. In addition, the platykurtic nature of the submission data suggested that a randomization model would be more powerful than ANOVA, and thus, the assignment submission dates were analyzed alone using randomization tests. All instruments were designed specifically for this study and included three measures of HTML achievement as well as measures of pacing preference, collaboration level, and study group membership.

3.1 Time Table

The study was conducted during Spring 2000 according to the schedule below.

Jan 14.	Discussed study with and demonstrated courseware to TAs
Feb 3.	Administered *study groups survey* to students
Feb 11.	Trained TAs on how to use grading rubrics
Feb 22.	Administered *pretest* and distributed courseware
Feb 25.	Assignments 1 and 2 were due
Mar 3.	Assignments 3 and 4 were due
Mar 10.	Assignments 5 and 6 were due
Mar 13.	Week of Spring Break
Mar 24.	Assignments 7 and 8 were due
Mar 28.	Administered *posttest*, and *pacing preference/collaboration survey*
Apr 27.	Administered *retention test*

The TAs were informed of the goals of the study and took an initial look at the courseware in a two hour meeting on January 14. Changes they recommended were incorporated into the courseware, including providing the students with alternative instructions in the event that the courseware did not start automatically when inserted into a CD-ROM drive and providing each TA with a list of his or her students and their respective treatment groups. The differences between treatments was explained and the TAs were told that it was not clear which group(s) would have the advantage in the long run. They were reassured that if significant differences were found, the grades for students in the disadvantaged group(s) would be curved upward.

In another two hour session on February 11 the TAs were trained on how to use the grading software and rubrics. It was hoped that, prior to this meeting, the teacher versions of the courseware would be available for them to take home and investigate. Unfortunately, the teacher versions were not ready for distribution during that time. The TAs received their copies of the courseware on the same day that the students received their copies. It was assumed that the TAs, being some of the top students from previous EdTech courses, would be able to complete the assignments one step ahead of their students. They indicated that they felt this was the case and did not require another training session. Later in the study, when an additional training session was offered again, the TAs again indicated that they did not require such instruction. Presumably they felt that the access they had to the grading rubrics and assignment solutions was sufficient.

The results of a survey on study groups, given in class on February 3, guided the random assignment of students to treatments. This randomization is described in detail in section 3.2.1. The pretest was given in class on February 22. Free CD-ROMs also were distributed to the students at that time. Assignments were due on Fridays: February 25, March 3, March 10, and March 24. The posttest and survey on pacing preference/collaboration level were given in class on March 28. The retention test was incorporated into Exam 2 for EdTech, which was given on April 27.

3.2 Sample

All students interested in entering the College of Education at the university from which the sample was drawn must take EdTech before being admitted to the college. The course introduces students to instructional tools made possible by advances in technology. Among other things, the students learn HTML. This study focused on the HTML portion of the class offered in Spring 2000 and investigated the success of the participants in learning it from the courseware provided.

All students met at the same time twice per week in a mass lecture with one of two lead instructors taking turns instructing them. Five TAs assisted the lead instructors by interacting with the same set of roughly 40 students each week. The TAs' duties included grading course work and helping students understand course materials. For each set of students assigned to a particular TA, one-third received treatment R, another third received treatment C, and the remaining third received treatment A.

3.2.1 Assignment to Treatments

As in past semesters, students were assigned alphabetically to TAs in roughly equal numbers. Due to the fact that some students dropped the course and some added it after this initial assignment took place, the TAs ended up with slightly different numbers of students at the end of the drop/add period. One TA had 46 students, one had 41, one had 35, and two more had 37 each. Such differences in group sizes were not expected to affect the statistical methods employed, because analysis was based on assignment to treatment conditions, not to TAs.

Of the 195 preservice teachers initially enrolled in EdTech, 6 officially dropped[1] the course after the drop/add period but prior to the beginning of the treatment interval. These students were excluded from all data analyses. The remaining 189 students were assigned randomly to treatment conditions in the following manner. First, responses to the survey in Appendix O, given in class prior to the treatment interval, revealed that some students in the class had established study groups. It was deemed necessary to average the scores of the members of each self-made study group and to treat each group as a single data point, because ANOVA, MANOVA, and repeated measures[2] all require that observations be independent and are not robust to violations of this assumption. Furthermore, the members of each self-made group were assigned to the same treatment, so that averages were not taken across treatments. After all self-made groups were assigned randomly to one of three treatments, the remaining students were assigned randomly[3], so that each TA had roughly equal numbers of students in each treatment.

Of the 19 study groups identified prior to the treatment interval, 7 were assigned to R, 6 to C, and 6 to A. The groups were comprised of 47 total students and each had between 2 and 6 members, with a mode group size of 2. Random assignment based on group, resulted in 18 individuals being assigned to group R, 14 to C, and 15 to A. Unfortunately, responses to the survey in Appendix P indicated that students did not maintain their study groups when working on the HTML assignments. In fact, some new study groups formed. Only 7 of the new groups appeared stable in the sense that all members reported working with each other member. All 7 groups were comprised of 2 members each, 4 were contained within a single treatment[4] and 3 spanned treatments. Also, many students' reports did not agree with one another. One student would list a particular partner, while that partner would list no one or perhaps even a different third person. Thus, it appeared that membership in self-made study groups was more fluid than anticipated.

Of the 19 initial groups, only 8 maintained their integrity[5]. However, because random assignment was based on the initial 19 groups and the "justification for [the randomization] approach is clearly strongest in an experimental situation" (Manly,

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[1]These six students initially had study identification numbers 114, 135, 189, 241, 273, and 277. Four were assigned to A, one to C, and one to R.

[2]The decision to analyze the data using a randomization model was not made until later, after all data were collected.

[3]Three students (#292, #293, #294), who had the same TA and added the class late but before the treatment interval, were assigned randomly, one to each treatment, after the initial group of individuals was assigned.

[4]Members of two groups were in R, members of one were in C, and members of the other were in A.

[5]The eight stable groups were comprised of 17 individuals with a mode of 2 members per group.

1997, p. 22), these groupings were kept for analysis of the achievement and procrastination data, with 19 average scores replacing the 47 individual scores. Following a similar argument, averages were not taken for the members of groups which emerged during the treatment interval, because these groups did not inform the initial random assignment of participants to treatments. However, because the preference data were analyzed using ANOVA, which is also strongest in an experimental situation but further requires that observations be independent, it was more appropriate to consider averages for the stable, emergent groups as well as for the initial 19 groups. First, based on responses to the survey in Appendix P, student #174 was added to group 14, so that 48 rather than 47 individual scores were replaced with 19 averages. Second, 4 averages were used for the 8 students in the stable, emergent groups where both members had the same treatment. Because only 6 students were in stable, emergent study groups which spanned treatments, it was expected that their dependence would not have a significant impact on analysis.

At the end of the course, data revealed that three students had a grade of 0% in EdTech (#136, #246, #249), presumably having never showed up for the class. One of these three, #249, actually did drop the class officially during the treatment interval. One more student, #158, dropped during the treatment interval, but completed no HTML assignments and no study related measures. In fact, as was the case for the other three students, this student likely never received the courseware, because no pretest was taken. It was presumed that all of these students actually had stopped attending class prior to the start of the study. Four more students experienced technical difficulty beyond their control during the study. One student's name included punctuation (#122), which caused the script for submitting assignments electronically to malfunction. The student was not able to submit several assignments during initial attempts due to this limitation in the submission procedure. Another technical problem which occurred during production of the CD-ROMs caused three unreadable CD-ROMs in a row to be produced. The affected students (#221, #222, #224) were in alphabetical order and all in group A. Even though all four students who experienced technical difficulty were in group A, it was presumed that these difficulties were not systematic. It was equally likely that a student in R or C might have had a name containing punctuation and that the unreadable CD-ROMs might have been created during the production of CD-ROMs for students in R or C. Therefore, data for these eight students were removed from analysis with the expectation that randomization was not adversely affected.

In summary, after removing 6 students who dropped EdTech before the study began, 3 students who presumably never attended EdTech although they were officially enrolled, 1 student who appeared to have dropped unofficially prior to the start of the study and officially after it started, and 4 students who experienced technical difficulties during the study, the initial 195 participants was reduced to 181 with 64 in R, 60 in C, and 57 in A. However, recall that for the preference data, 23 averages were generated from 56 individuals in self-made study groups, yielding 148 total data points, 51 of which were assigned to R, 50 to C, and 47 to A. For the achievement and procrastination data, 19 averages were generated from 47 individuals in self-made study groups, yielding 153 total data points, 53 of which were assigned to R, 52 to C, and 48 to A.

Three sets of CD-ROMs were made, one for each type of deadline. Each CD-ROM in the set that contained absolute deadlines was labeled 1.2a on the actual CD-ROM and on the initial splash page of the courseware as well as on the bottom of the main navigation bar on the left (see Figure 29). Likewise, the sets containing conditional and recommended deadlines were labeled 1.2c and 1.2r, respectively. These labels were put in place so that TAs could quickly identify students' treatment conditions when answering questions in the computer laboratory. If a student asked a question about deadlines, it was expected that this information would be helpful in guiding the TA's response. It also helped to ensure that each student received the correct version of the CD-ROM. In addition, a slip of paper was included with each CD-ROM indicating precisely which student should receive it as well as the four-digit password the student would need to submit assignments online.

3.2.2 Missing Data

Several students were missing data, with 3 missing the pretest, 34 missing the posttest and pacing preference survey, and 23 missing the retention test. In fact, 20 were missing both the posttest and the retention test. Of these 20, 10 officially dropped the course after the study began but on or before March 10, which was the last day to drop or withdraw from courses at the University without academic penalty. This occurred at the end of the third week of the five week treatment interval. All 10 dropped EdTech within an eight day period. The other 10 students who were missing both the posttest and retention test, did not officially drop the course. However, their scores on EdTech's Exam 1, taken on the third day of the study, and their final class standings, gave supporting evidence that at least some may have dropped unofficially (see Table 3). While their Exam 1 scores appeared roughly equivalent, their final class standings were much more diverse. It was likely that some chose to drop, but just missed the University's final drop date. In any case, it was not clear that their assignment information was complete. Thus, there was no reasonable way to estimate missing scores for these 20 individuals, and their data were removed from analysis.

In order to guage the impact of removing this data, first notice that equal numbers of students were removed from each treatment. Next, consider the collective Exam 1 scores and final grades recorded in EdTech for these students, which were significantly correlated with posttest and retention test scores (see Table 6). Relatively speaking, their average scores on the posttest and retention test likely would

Table 3. Grades for Students Missing Posttest and Retention Test

Treatment	n	Exam 1			Final Grade		
		M	Min	Max	M	Min	Max
Students who dropped							
R	3	48.67	30	63	122.00	81	166
C	3	43.67	35	50	117.67	98	136
A	4	55.50	47	62	165.25	139	180
Students who did not drop							
R	3	47.33	40	53	123.33	98	142
C	4	50.25	39	61	209.00	90	375
A	3	50.00	47	54	104.00	87	135
All 20 students							
R	6	48.00	30	63	122.67	81	166
C	7	47.43	35	61	169.86	90	375
A	7	53.14	47	62	139.00	87	180

have been similar to their scores on Exam 1 and their final grades. Although the Exam 1 scores were not correlated as highly with the study achievement scores as the final grades, they also were not affected by the date the student (un)officially dropped the course. Therefore, they provided the best evidence of any possible differential effects. Because students in A, on average, earned half a grade higher than students in both R and C, the most likely effect was that the mean posttest and retention test scores for students in A were a little lower relative to students in R and C than they would have been had these 20 data points been retained. Still, the students did not appear to be related in any systematic way, and because the amount of missing data was distributed equally across groups, it was expected that the removal of the scores of these students would not drastically alter the results of analyzing the achievement data. Furthermore, with low correlations between the pretest and the posttest ($r = .06$) and the pretest and retention test ($r = .10$) and with incomplete assignment data, there was no reasonable way to estimate the missing values.

Besides the 20 students missing both the posttest and the retention test, there were 14 more who were missing the posttest only and 3 more who were missing only the retention test. In addition, one student in A reported a missing posttest score on the day the retention test was given. That student was allowed to retake the posttest the following week. Because this student took the posttest after the retention test, the actual recorded posttest score was not used during data analysis, bringing the total number of students missing the posttest only to 15. Of these

15, 8 were in R, 2 were in C, and 5 were in A. Because these missing data were not distributed equally across groups and because the posttest and retention test were significantly correlated ($r = .83$, $p < .0001$), missing posttest scores were estimated using retention test scores and vice versa.

Simple linear regression was performed on the posttest and retention test scores of the 143 students who had complete records for both of these measures, generating the prediction equation

$$p = 0.93563r + 11.16920 + 12.22269e,$$

where p is the estimated posttest score, r is the retention test score, and e is a random variable from a normal distribution with a mean of 0 and a standard deviation of 1. The latter term was included so that the distribution of noise in the estimated missing values would be similar to that found during regression analysis on the available data. Thus, it was necessary to multiply e by the standard error of the estimate associated with the regression equation, or by 12.22269.

As was the case for the posttest scores, the missing retention test scores were not equally distributed across treatments. Two students were in A and one was in R. Therefore, regression analysis was used to generate the equation

$$r = 0.77697p + 1.51457 + 11.13819e,$$

where r is the estimated retention test score, p is the posttest score, and e is a random variable in $N(0,1)$.

These final two regression equations are graphed over their respective scatter plots in Figures 1 and 2. Note that both equations accounted for 73% of the variability in the dependent variables. While the typical prediction errors for the equations (12.22 and 11.14, respectively) indicate that predictions, on average, were inaccurate by a letter grade, they were still more accurate than they would have been if the mean were used. This same argument is assumed to hold even though the reliabilities of the posttest ($r = .89$) and the retention test ($r = .85$) imply that the regression coefficients were underestimated somewhat (Pedhazur, 1997). To review all values imputed via regression, see the boxed posttest and retention test scores in Table 25.

A final observation regarding the posttest is worth mentioning. Note that one student, #187, responded with the answer C for every question (see Table 22). Normally, this student's responses would be removed. However, because the course material did appear to be more challenging for the students than anticipated, with a subset of students from each group earning scores on the achievement measures

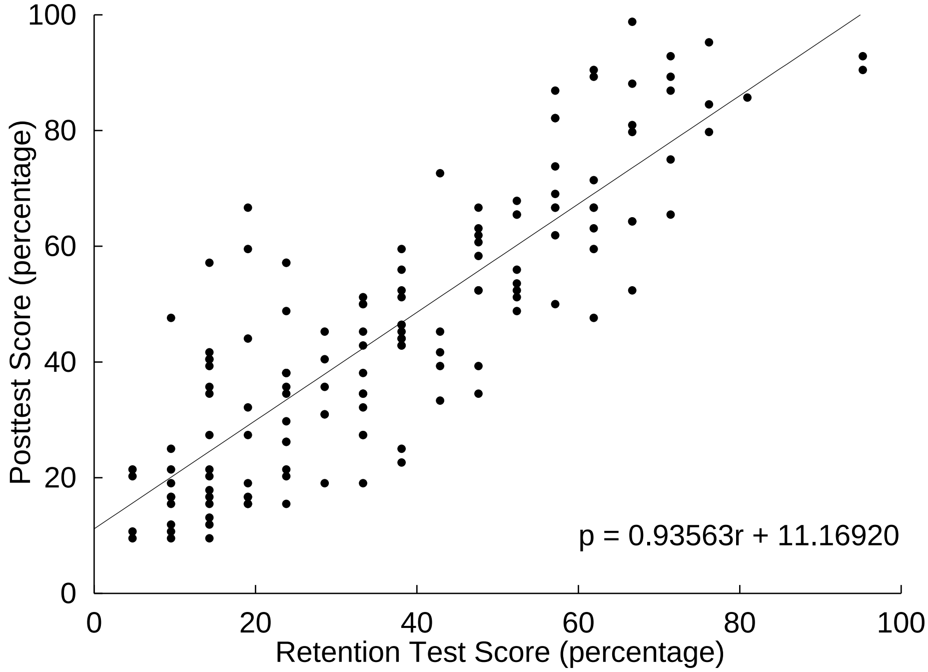

Figure 1. Predicting posttest score from retention test score.

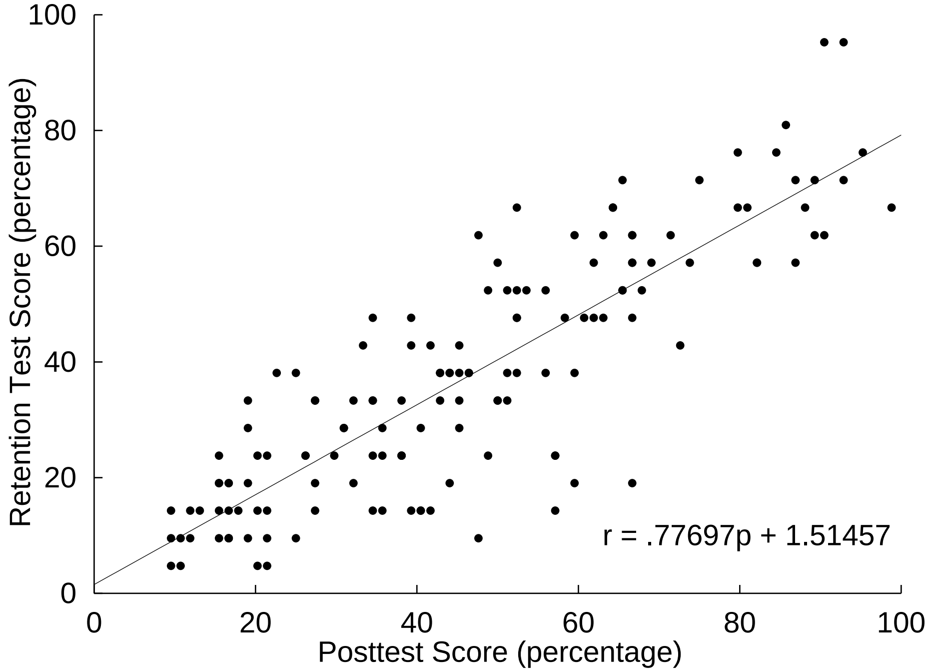

Figure 2. Predicting retention test score from posttest score.

that one would expect by chance, this student's responses were kept. Presumably, some number of students in each group guessed for all questions. Student #187 was just the only one that did so in such a systematic manner.

Only three students were missing the pretest, but according to Table 6, the multiple choice portion of the test had low reliability with $\alpha = .01$ and was not highly correlated with any other measures. Therefore, the best estimate for the missing scores was the average pretest score of 27.15 and the average self-report responses on items 10 and 11 of 1.5 and 1.34, respectively. Although it was not included in formal data analysis due to its extremely low reliability, the pretest did provide some evidence that initial randomization produced three similar groups with respect to prior knowledge of HTML, with mean scores of 27%, 29% and 25% for R, C, and A, respectively. In fact, randomization tests[6] based on the pretest multiple choice items ($p = .2797$) and self-report items 10 ($p = .2781$) and 11 ($p = .1268$) showed no initial difference between groups. It should be noted that some students were missing individual item responses on the pretest. Their scantrons and test forms were inspected, and in three cases, the responses were easily corrected (see footnotes for Table 22). In another five cases, missing responses for multiple choice items were treated as incorrect responses. Finally, eight missing self-report items were replaced with the average responses across all data points. Specifically, 1.5 was recorded for one student who did not answer item 10 about prior experience with typesetting languages, and 1.34 was recorded for seven students who did not answer item 11 about prior experience with programming.

Now consider missing preference data. One student neglected to answer question 8, so a value of 3 for *No Preference* was entered. The same 35 students who were missing the posttest also had no pacing preference scores. The 20 who also were missing the retention test and whose data were not included in the analysis of the achievement data were removed from consideration here as well. For the remaining 15, the average pacing preference score of 2.79 ($N = 146$) was used, because it was the best available estimate for the missing values.

In the case of a missing assignment score, it was assumed that the student did not submit the assignment and a zero score was entered. Recall that, to determine the level of procrastination, the submission date for each assignment was

[6] The comparison test statistic selected for the multiple choice items was the two-sided omnibus test $(\overline{PRE}_r - \overline{PRE}_c)^2 + (\overline{PRE}_r - \overline{PRE}_a)^2 + (\overline{PRE}_c - \overline{PRE}_a)^2$, where $\overline{PRE}_g$ is the average pretest score for group g and $g \in \{r, c, a\}$. Two similar two-sided omnibus tests were used to analyze the two self-report items individually. In all cases, estimates were based on permutation distributions of size 1000000. Randomization tests were preferable to ANOVAs, because the multiple choice items for group A were platykurtic (see Table 11), and the self-report items generally were positively skewed and leptokurtic (see Table 7). See section 4.3 for details about employing randomization tests.

Table 4. Sample Sizes as Distributed Across TAs

Treatment	n^a	TA 1	TA 2	TA 3	TA 4	TA 5
				All individuals		
R	58	15	11	13	10	9
C	53	12	9	12	9	11
A	50	11	11	11	8	9
		Achievement and Procrastination data groups[b]				
R	48	14	11	12	8	9
C	47	12	9	11	8	11
A	41	11	8	11	8	9
		Preference data groups[bc]				
R	46	14	11	12	8	9
C	45	12	8	11	8	11
A	40	11	8	10	8	9

[a] Number of individuals and data points considered. Because study group members might have had different TAs, study groups were sometimes included in more than one of the TA totals. Therefore, row totals do not necessarily sum to this value. [b] Counts include individuals and study groups, such that each study group was counted only once for a given TA, regardless of how many members had that TA. [c] A study group was included in the count for a given TA, if any of its members had that TA. Hence, emergent groups that had members with different TAs were included in the counts of more than one TA.

recorded. For those students who did not submit an assignment, the day after the study ended was entered as the submission date.

In summary, after handling missing data, 161 individuals remained with 58 in R, 53 in C, and 50 in A. After averaging the scores for individuals in self-made study groups for the achievement and procrastination data, a total of 136 data points were available for analysis, with 48 in R, 47 in C, and 41 in A. After including emergent group averages for the preference data, a total of 131 data points were available, with 46 in R, 45 in C, and 40 in A. Table 4 lists how many of the 161 individuals and the 136 or 131 data points were assigned to each treatment/TA combination. Notice that, for a given TA, the number of observations in each treatment was roughly the same, before and after taking study group averages.

3.2.3 Effect Size and Power

Given reports by researchers who have compared deadline contingencies under conditions of PSI, no significant difference was anticipated in immediate achievement scores on the posttest. Based on effect sizes reported for retention test scores of students who engaged in massed practice versus distributed practice, a large effect size was anticipated for retention test scores. Using formula $\hat{f} = \sqrt{(k-1)F/N}$, where k is the number of groups, F is the reported F-value, and N is the total sample size (Stevens, 1990), in one study the effect size came out to be $\hat{f} = .37$ (Bloom & Shuell, 1981), and in another it came out to be $\hat{f} = .65$ (Grote, 1995)[7]. In both cases, distributed practice was superior to massed practice. Therefore, a large effect size was expected for the retention test scores earned by students in groups C and A as compared to those earned by students in group R, who were expected to procrastinate more and to mass their learning near the final due date.

Recall that the achievement data were to be analyzed using repeated measures, but that a randomization approach was adopted instead due to the abnormal nature of the data. According to Manly (1997), "it is reasonable to expect that the power of randomization and classical tests should be about the same when the assumptions [for the classical tests] are true....When data are from nonstandard distributions, there is some evidence to suggest that randomization tests have more power than classical tests" (p. 80). Randomization was used to compare the difference scores generated by subtracting the retention test scores from the posttest scores. The average difference scores for the three groups of interest were compared by subtracting them from one another. Therefore, the test likely had at least the same power as ANOVA with two degrees of freedom (3-1), and possibly more power. Given an average group size of 45 and $\alpha = .05$, the F test would have had a 73% chance of detecting just a medium-sized effect ($\hat{f} = .25$) for the difference scores. For a large effect size ($\hat{f} \geq .40$), it would have had a 99% chance (Stevens, 1990). However, it only would have had about a 16% chance of detecting a small effect. Like the achievement data, the abnormal nature of the procrastination data prompted the use of the randomization approach, and power issues are similar to those just discussed. Considering the pacing preference data with an average group size of 44 and $\alpha = .05$, this study again had some power to detect a medium (73%) or large (99%) effect, given that a one-way ANOVA was employed. In summary, there presumably were enough data points to provide fairly reasonable power of detecting either a medium or a large effect of the treatment condition on the achievement, pacing preference, and procrastination data, but not a small effect.

[7] For Bloom and Shuell (1981), the calculation was $\sqrt{7.12/52}$. For Grote (1995), it was $\sqrt{15.06/36}$.

3.3 Treatments

As mentioned previously, the students were supplied with one of three versions, 1.2r, 1.2c, or 1.2a, of the courseware on CD-ROM. Version 1.1 was created and used during a pilot study conducted in Fall 1999. Modifications inspired by the pilot study were incorporated into Version 1.2. See Appendix A for more information on the pilot study. For a detailed description of Version 1.2, including changes made based on the pilot study, see Appendix C. For a discussion of the courseware versions supplied on the CD-ROM accompanying this dissertation, see Appendix U.

The only difference between versions 1.2r, 1.2c, and 1.2a was that the deadlines supplied were specified as recommended (R), conditional (C), or absolute (A). All groups received a list of the same deadlines. Group R was told that the deadlines were merely recommended and that all assignments were due absolutely no later than March 24. For the exact wording, see Figures 3 and 4. Group C received further information on dates by which assignments could be submitted for bonus points or with penalty points deducted (see Figures 5 and 6). Group A was told that absolutely no assignment could be submitted after its listed due date (see Figures 7 and 8).

All students were informed that they were part of a study and that the deadline contingencies were slightly different for the different groups. Because they were likely to discover this information on their own and possibly be concerned about it, and because knowledge of this information was not expected to affect their actions[8], it seemed advisable to supply them with this information systematically. They were reassured that it was not clear which group, if any, would have the advantage in the long run. They were informed that, in the event that one group did have a clear advantage, scores for this portion of EdTech would be curved upward for the disadvantaged group(s), so that the means for each group were comparable. The exact information supplied to each of the groups appears in Figure 9.

3.4 Instruments

The outcomes fell into three main categories. One set measured achievement in terms of student posttest and retention test scores. Another set focused on student satisfaction as measured by preference for self-pacing versus instructor-pacing. A third set measured procrastination in terms of when assignments were submitted relative to due dates and how often deadline extensions were requested. Each set of measures is discussed in detail below.

[8]They could not switch groups or gain access to the various treatments.

Final Product (4:10) Print

Due dates for intermediate work (1:01) absolutely NO assignments accepted after **3/24**

Submission procedure (0:24)

#	Assignment Description	Lessons	References XLink	Pts	Recommended Due Date
1	Create Index Page (2:34) Submit Print	Development (7:32) Design (6:25)	HTML HEAD TITLE BODY CENTER BR FONT A entities	4	2/25
2	Create Template File (5:28) Submit Print	Tags and Attributes (9:14) Document Structure (5:11)	colors	4	2/25
3	Create Personal Page (1:39) Submit Print	Logical and Physical Tags (5:20)	H1 P	4	3/3
4	Create Links Page (3:42) Submit Print	Lists (2:08)	H2 H3 UL LI	8	3/3
5	Add Images (6:56) Submit Print	Simple Image (2:32) Clickable Image (6:38) Image Swapping (6:22)	IMG MAP AREA	4	3/10
6	Create Professional Page (3:03) Submit Print	Tables (7:41)	TABLE TR TH TD	4	3/10
7	Update Links Page (5:23) Submit Print	Frames (10:41)	FRAMESET FRAME NOFRAMES A	4	3/24
8	Update Personal Page (5:12) Submit Print	Forms (9:56)	FORM INPUT	4	3/24

Figure 3. Assignment due dates for treatment R.

Dear Student,

This courseware is being provided to you free of charge for the purpose of teaching you HTML as well as for the purpose of collecting data for a study investigating the effects of different types of deadlines. Based on random assignment, you will be supplied with RECOMMENDED due dates for each intermediate assignment. THESE DUE DATES ARE MEANT ONLY AS A GUIDE. YOU NEED NOT MEET ANY BUT THE FINAL ONE OF MARCH 24. If you would like to learn more about the various deadline contingencies being investigated, please visit the study Web site.

ALL INTERMEDIATE ASSIGNMENTS ARE DUE BY MARCH 24. ABSOLUTELY NO ASSIGNMENTS WILL BE ACCEPTED AFTER MARCH 24. WHILE YOU ARE NOT REQUIRED TO MEET THE OTHER DUE DATES, IT IS RECOMMENDED THAT YOU ATTEMPT TO MEET THEM ALL IN ORDER TO COMPLETE ALL INTERMEDIATE ASSIGNMENTS IN A TIMELY FASHION.

You need not worry whether or not students with other types of deadlines have an advantage for lab 4. Due to a number of factors, it is not clear which group(s), if any, will have an advantage. If a significant difference is found between groups, then the grades on this lab for the group(s) with the lower average(s) will be curved upward.

Figure 4. Due date description for treatment R. Text in all capital letters indicates those portions which differ from the text given to students in the other two treatments. None of the text supplied to the students was actually in all capital letters.

Final Product (4:10) Print

Due dates for intermediate work (1:37) absolutely NO assignment accepted after specified penalty due date

Submission procedure (0:24)

#	Assignment Description	Lessons	References XLink	Pts	Due Date	Bonus Due Date	Penalty Due Date
1	Create Index Page (2:34) Submit Print	Development (7:32) Design (6:25)	HTML HEAD TITLE BODY CENTER BR FONT A entities	4	2/25	-	2/28
2	Create Template File (5:28) Submit Print	Tags and Attributes (9:14) Document Structure (5:11)	colors	4	2/25	-	2/28
3	Create Personal Page (1:39) Submit Print	Logical and Physical Tags (5:20)	H1 P	4	3/3	2/28	3/6
4	Create Links Page (3:42) Submit Print	Lists (2:08)	H2 H3 UL LI	8	3/3	2/28	3/6
5	Add Images (6:56) Submit Print	Simple Image (2:32) Clickable Image (6:38) Image Swapping (6:22)	IMG MAP AREA	4	3/10	3/6	3/13
6	Create Professional Page (3:03) Submit Print	Tables (7:41)	TABLE TR TH TD	4	3/10	3/6	3/13
7	Update Links Page (5:23) Submit Print	Frames (10:41)	FRAMESET FRAME NOFRAMES A	4	3/24	3/20	-
8	Update Personal Page (5:12) Submit Print	Forms (9:56)	FORM INPUT	4	3/24	3/20	-

Figure 5. Assignment due dates for treatment C.

Dear Student,

This courseware is being provided to you free of charge for the purpose of teaching you HTML as well as for the purpose of collecting data for a study investigating the effects of different types of deadlines. Based on random assignment, you will be supplied with CONDITIONAL due dates for each intermediate assignment. If you would like to learn more about the various deadline contingencies being investigated, please visit the study Web site.

TO RECEIVE FULL CREDIT FOR AN INTERMEDIATE ASSIGNMENT, YOU MUST SUBMIT IT BY THE LISTED DUE DATE. IF YOU SUBMIT IT BEFORE THE BONUS DUE DATE, YOU WILL RECEIVE AN ADDITIONAL POINT. FOR EXAMPLE, IF THE ASSIGNMENT IS WORTH 4 POINTS, THEN YOU CAN EARN A MAXIMUM OF 5 POINTS TOTAL FOR IT. IF YOU SUBMIT THE ASSIGNMENT LATE (AFTER THE DUE DATE), BUT BEFORE THE LISTED PENALTY DUE DATE, THEN 1 POINT WILL BE DEDUCTED FROM YOUR GRADE FOR THIS ASSIGNMENT. IN THAT CASE, FOR AN ASSIGNMENT WORTH 4 POINTS, YOU COULD EARN A MAXIMUM OF 3 POINTS. **ABSOLUTELY NO INTERMEDIATE ASSIGNMENT WILL BE ACCEPTED AFTER ITS RESPECTIVE PENALTY DUE DATE.** (NOTE THAT ASSIGNMENTS 7 AND 8 WILL NOT BE ACCEPTED AFTER 3/24.)

THE 8 POSSIBLE BONUS POINTS YOU MAY POTENTIALLY EARN CAN BE THOUGHT OF AS APPLYING TOWARD YOUR HTML POSTTEST, WHICH IS WORTH 24 POINTS, AND/OR TOWARD POINTS MISSED ON THE HTML ASSIGNMENTS. THE BONUS POINTS WILL NOT BE CARRIED OVER TO THE REST OF THE CLASS. FOR THIS LAB ON HTML, YOU MAY EARN A MAXIMUM OF 60 POINTS.

You need not worry whether or not students with other types of deadlines have an advantage for lab 4. Due to a number of factors, it is not clear which group(s), if any, will have an advantage. If a significant difference is found between groups, then the grades on this lab for the group(s) with the lower average(s) will be curved upward.

Figure 6. Due date description for treatment C. Text in all capital letters indicates those portions which differ from the text given to students in the other two treatments. None of the text supplied to the students was actually in all capital letters.

Final Product (4:10) Print

Due dates for intermediate work (0:42) absolutely NO assignment accepted after specified due date

Submission procedure (0:24)

#	Assignment Description	Lessons	References XLink	Pts	Due Date
1	Create Index Page (2:34) Submit Print	Development (7:32) Design (6:25)	HTML HEAD TITLE BODY CENTER BR FONT A entities	4	2/25
2	Create Template File (5:28) Submit Print	Tags and Attributes (9:14) Document Structure (5:11)	colors	4	2/25
3	Create Personal Page (1:39) Submit Print	Logical and Physical Tags (5:20)	H1 P	4	3/3
4	Create Links Page (3:42) Submit Print	Lists (2:08)	H2 H3 UL LI	8	3/3
5	Add Images (6:56) Submit Print	Simple Image (2:32) Clickable Image (6:38) Image Swapping (6:22)	IMG MAP AREA	4	3/10
6	Create Professional Page (3:03) Submit Print	Tables (7:41)	TABLE TR TH TD	4	3/10
7	Update Links Page (5:23) Submit Print	Frames (10:41)	FRAMESET FRAME NOFRAMES A	4	3/24
8	Update Personal Page (5:12) Submit Print	Forms (9:56)	FORM INPUT	4	3/24

Figure 7. Assignment due dates for treatment A.

Dear Student,

This courseware is being provided to you free of charge for the purpose of teaching you HTML as well as for the purpose of collecting data for a study investigating the effects of different types of deadlines. Based on random assignment, you will be supplied with ABSOLUTE due dates for each intermediate assignment. **ABSOLUTELY NO INTERMEDIATE ASSIGNMENT WILL BE ACCEPTED AFTER ITS RESPECTIVE DUE DATE.** If you would like to learn more about the various deadline contingencies being investigated, please visit the study Web site.

You need not worry whether or not students with other types of deadlines have an advantage for lab 4. Due to a number of factors, it is not clear which group(s), if any, will have an advantage. If a significant difference is found between groups, then the grades on this lab for the group(s) with the lower average(s) will be curved upward.

Figure 8. Due date description for treatment A. Text in all capital letters indicates those portions which differ from the text given to students in the other two treatments. None of the text supplied to the students was actually in all capital letters.

Deadline Contingencies Under Investigation

You are participating in a study investigating the effects and implications of various deadline contingencies. You have been assigned randomly to one of three groups. Students in each group will face different consequences based on when they submit assignments relative to the supplied due dates for lab 4. Keep in mind that if there is a significant difference in grades between the groups, then the grades of the students in the group(s) with the lower average(s) will be curved upward. For example, say that the students in one group earn 55 out of 60 points, on average. Say that the other two groups earn 40 and 45 points, on average. Then 15 and 10 points will be added to all student's scores in these two groups, respectively.

The three deadline contingencies under investigation include recommended, conditional, and absolute deadlines. Note that all groups have four deadlines, one on each Friday during the study. Only the consequences of not meeting these deadlines varies between groups.

Recommended

Intermediate due dates are merely *recommended*. All assignments are actually due by 3/24. No assignments will be accepted after this date.

Conditional

Assignments submitted by the Monday preceding the due date earn an additional bonus point that can be applied toward the posttest. Assignments submitted after the due date, but by the following Monday are assessed a penalty point. No assignment is accepted after its penalty due date. No bonus point is available for the first two assignments, and the last two assignments will *not* be accepted for partial credit after 3/24.

Absolute

No assignment will be accepted after its respective due date.

Figure 9. Deadline information supplied to all students.

3.4.1 Student Achievement

A search of the most recent Mental Measurements Yearbook yielded no instruments measuring achievement in HTML. Therefore, instruments were created specifically for this study. See the pretest, posttest, and retention test in Appendixes F, G, and H, respectively. Appendix E contains an annotated list of the questions on all achievement measures. For each item, the instructional objective (see Appendix D) it measures is noted along with the exams on which it appeared and whether or not it was used in the pilot study.

The posttest essay question (#46 in Appendix E) was very similar, but not identical, to the one that appeared on the pilot posttest. The main difference was that the posttest question for the actual study required the students to read new reference material on the WIDTH attribute of the HR tag. They had to use this information to complete the task, demonstrating an understanding of the general format for HTML tags and attributes as well as the ability to utilize reference material on an attribute not formally discussed in the courseware. In addition, they were asked to center the phrase *Check out my Web site!*. The essay question incorporated twelve items, while measuring the students' ability to apply what they had learned. A comparable essay question appeared on the retention test.

As indicated by the annotations in Appendix E, the pretest and retention test contained all of the same items, with the exception of the essay question, which only appeared on the retention test. A similar essay question, posed to the students on the first day of the pilot study, revealed no data of value. None of the students were able to make any reasonable attempt at answering the question. Therefore, no essay question was included on the pretest in the actual study.

Having identical questions on the pretest and retention test was not anticipated to be a problem, because students were not informed of their performance on the pretest, and the retention test was given two months after the pretest. It was unlikely that students were able to recall any of the questions on the pretest when taking the retention test. Furthermore, most students were not familiar with the HTML language when they took the pretest, and hence, were not likely to recall any of the questions.

Because it was more likely that students would recall questions from the posttest when taking the retention test, the posttest questions were completely distinct from those used on the retention test (and pretest). While this may weaken somewhat statements about changes in test scores across time, it strengthens those concerning recall of HTML on the retention test, because students were less likely simply to have memorized the answers to particular questions. Also, as discussed in section 3.4.1.2, care was taken to ensure that the questions on the posttest and the retention test were comparable in content, difficulty, and the weight of the tested courseware objectives.

3.4.1.1 Administration. Students took the pretest in class on Tuesday, February 22. They were compensated for their time with five extra credit points applied toward the class. They were informed that their responses would provide important data in determining the strength of conclusions drawn about the HTML portion of the class. In addition, they were reassured that their individual scores would not be associated with their course grade in any way, nor would their scores be shared with any course officials. Furthermore, they were told that they were not expected to know any of the answers at this point. See Appendix F for the exact wording. The pretest was short, containing only 11 questions, so that it required minimal class and student time (5-10 minutes). The students were not informed of their performance on this measure. The purpose of the pretest was strictly to verify that random assignment to treatments yielded roughly equivalent groups.

Four days after all treatments terminated on March 24, the posttest was administered in class (March 28). In keeping with the class practice of providing students with reviews prior to exams, a nine minute review of the main courseware topics was provided within the courseware under the *Test* main menu option. Students were informed of their scores on the posttest online, in the normal fashion set up for the class. The multiple choice portion was scored by machine, while the essay portion was scored by hand (see section 3.4.1.4). Student exams were kept on file in the TAs' office, so that the students could find out which questions they missed and examine feedback on their performance on the essay question. The TAs were supplied with a single copy of the solution code and grading rubric, which was kept in a secure location. In an interview conducted with four of the five TAs and both of the course facilitators after EdTech ended, all parties present reported that no students requested a review of their posttest responses.

The retention test questions were given as part of EdTech's Exam 2 on April 27. They consisted of the same nine HTML achievement questions[9] that appeared on the pretest along with an essay question very similar to the one on the posttest. Every attempt was made to create an instrument distinct from the posttest, but of comparable difficulty (see section 3.4.1.2). The retention test was short[10] in order to incorporate it reasonably into Exam 2 and to minimize the amount of class and student time required. Students were informed of their performance in terms of their score on the entire exam.

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[9] The pretest contained nine multiple choice items measuring HTML achievement and two self-report items measuring prior experience with typesetting and programming.

[10] See section 4.1 for a discussion of the preliminary data analysis used to predict the impact this might have on reliability.

3.4.1.2 Development. The achievement measures for the pilot study were not created in a systematic manner. Therefore, new measures based on the courseware objectives listed in Appendix D were created for the actual study. The weight of each objective is indicated in terms of the number of questions that measured it on the achievement tests for the actual study. After relative weights were determined for each objective, proportionate numbers of items measuring these objectives were borrowed from the pilot posttest. New items were created where needed. Of the 37 multiple choice items on the pilot posttest, 18 were retained as written[11], and 8 more were retained in modified form. In all, 26 multiple choice items out of 37 were retained, and 19 new ones were created.

The number of items covering each objective on the pilot posttest was not well balanced. Of the 11 multiple choice items not retained, 6 were deleted, because the objectives they measured were over represented. In 5 out of 6 cases, the decision regarding which of several items measuring the same objective to delete was based on which item would increase Cronbach's alpha most with its removal. In the 6^{th} case[12], the decision was based on which item best covered the implicit courseware objectives. Because they did not cover any of the objectives in Appendix D, 4 more of the 11 multiple choice items were removed. Finally, the 11^{th} item was not retained, because it disagreed somewhat with the message delivered by the courseware.

Now consider the eight items from the pilot posttest that were modified for the actual study instruments. Five were altered, so that they would have four choices, rather than only two or three. For the other three, the choices were altered to better match the current state of the courseware as well as other questions on the exam. Analysis of pilot study data on the 26 retained items suggested that it was reasonable to retain them all, because $\alpha = .72$ and removing a single item at a time yielded $\alpha \in [.68, .74]$.

Every attempt was made to create items for each objective with similar difficulty levels. Then, for each objective, a die was rolled to determine which of the items measuring it would appear on the posttest and which would appear on the pretest/retention test. Appendix E lists all items in the same order as the objectives. Each item is annotated with its target objective, alternative objectives identified by experts (see section 3.4.1.3), the correct response, and the instrument(s) upon which it appeared.

[11] In some cases, the multiple choice responses for these items appear in a different order.

[12] In this case, item analysis using Cronbach's alpha indicated that an alternative candidate would be the best one to remove. However, upon consultation with the course facilitator who participated in the pilot study, a key element on an associated grading rubric was not checked when student assignments were graded. If it had been checked, it was anticipated that student performance on this item would have been substantially different. In addition, only three of the students completed the assignment associated with this item.

The order of the multiple choice items was rearranged for review by two experts and for the creation of the the achievement instruments. All multiple choice items consisted of a stem followed by four responses, one correct and three distractors. The posttest contained seven items with the choice *more than one of the following*, which was the correct response in three cases. The pretest/retention test contained three such items, with this choice correct in one case. Note further that the posttest contained two items with the choice *all of the following*, which was correct in one case. Finally, correct responses were evenly distributed across choices. On the posttest, A was the correct choice nine times, as was B, C, and D. On the pretest/retention test, A was the correct choice three times, while B, C, and D were each correct twice.

3.4.1.3 Validity. Recreating the achievement measures in a systematic fashion based on the implicit courseware objectives was an initial attempt at generating instruments with content validity. This validity was further checked in a systematic review by two independent experts on HTML. Appendix I contains the letter and questions posed to these experts.

The letter began by asking the experts to rate a self-report question on the pretest concerning prior experience with typesetting languages such as LaTeX. Based on recommendations from the first expert, the question was expanded to include programming languages such as Ada, BASIC, C, Cobol, Fortran, Java, JavaScript, LISP, Pascal, Visual Basic, and Visual C. The second expert was given the question in the form in which it appears in Appendix I. Based on comments from this expert[13], it was further expanded to include authoring languages such as Authorware, IconAuthor, and Quest. It was also simplified by splitting it into two questions and only requiring the student to respond to two items rather than to fifteen. See the last two questions on the pretest in Appendix F to see the final form of these questions.

In addition to the letter, the experts were given a copy of the objectives in Appendix D and asked to comment on their appropriateness as well as on the relative weightings assigned to each. Both experts agreed that the objectives and weightings were reasonable. Neither indicated that any important objectives had been left out. However, examination of the retention test data did indicate that an adjustment of the weighting scheme was warranted. The essay portion of the exam produced much more reliable scores than the multiple choice portion. Therefore, rather than rescale each essay item by a factor of 0.25 as initially planned, the items were left

[13]Expert 2 also mentioned that, while not supported by empirical data, a background in symbolic notation systems such as music, Mathematics, electronic circuitry, and schematics might give students an advantage. While such experiences may be advantageous in learning HTML, the face validity of the pretest would likely be lowered by the inclusion of items measuring them. In truth many prior experiences may play a role in how easily students learn HTML, including fixing an automobile, which requires skill at problem solving.

unscaled. This increased Cronbach's alpha for the retention test scores from .70 to .85. It also had the effect of increasing the weights of objectives 3 and 4 to 29% and decreasing the weights of objectives 6-10 to 5% (see Table 8). This seemed reasonable, because objectives 3 and 4 are arguably more general. In fact, expert 2 noted the general nature of objective 4 in an unsolicited written comment during the initial review. Furthermore, expert 1 found the alternative weighting scheme reasonable during a followup review.

To ensure that the posttest and retention test still were comparable measures, the weighting scheme was adjusted for the posttest items as well. For data analysis only[14], each correct essay item on the posttest was recorded as a 4 rather than a 1, so that the weight of each essay item on both measures was increased by a factor of four. See Appendix D for the final weighting scheme and Table 8 to compare this weighting scheme with the original one. As a final note on the scope of the objectives, Expert 2, having had experience with EdTech and the students involved, did indicate some concern over the amount of material covered, and in fact, the students did report (see item 6 in Appendix P) spending seven hours per week, on average, completing assignments for the study. This was more than anticipated based on pilot study data (see Appendix C).

The experts also were asked to consider each item in turn. They were given a form (see Appendix J) with a box to the right of each item. In each box, they were asked to indicate which objective(s) they thought the corresponding item covered. They were also asked to indicate if they thought the item was clear, was too difficult, needed to be reworded, and/or needed to be removed. Space was provided for them to make any other comments, and they were encouraged to mark changes on the items where needed. Expert 1 indicated that answers a and b for question 29 were not distinct enough and might be confused. Below is the original question as reviewed by expert 1.

29. It is possible to ____________ a submit button.

   (a) fill the contents of
   (b) change the message displayed on
   (c) change the source referenced on
   (d) fill the image field of

[14] Students' HTML grades in EdTech were based on the original weighting scheme.

The stem and first and last responses were changed as follows and supplied to expert 2.

29. It is possible to change the ____________ a submit button.

(a) range of

(b) $\boxed{\text{message displayed on}}$

(c) source referenced on

(d) type of

Expert 2 recommended that items 30, 35, and 43 be reworded to improve their clarity. Unfortunately, these recommendations were inadvertently left out of the final versions of the instruments. The recommended change to question 30 was fairly minor as indicated by the inclusion of the italicized text below.

30. What attribute of the FRAME tag must be set in order to use it as a target for A *(or anchor)* tags?

(a) TARGET

(b) $\boxed{\text{NAME}}$

(c) SRC

(d) HREF

Therefore, it is expected that leaving it unchanged did not impact its effectiveness greatly. The changes recommended for questions 35 and 43 were more substantial. Again, changes appear in italics.

35. If you want to *improve your web page so that a particular image* downloads and displays faster, what should you do?

(a) more than one of the following

(b) *reduce the width or height specification in the IMG tag*

(c) do not specify a width or height for the image

(d) $\boxed{\text{open the image in an image editor and make it smaller}}$

43. *If you want a new page displayed after clicking a link in a frame, so that all the frames are wiped out and the page is displayed in the entire browser window, to what should you set the TARGET attribute of the A (or anchor) tag?*

(a) _blank

(b) _window

(c) $\boxed{\text{\_top}}$

(d) _new

Although these recommendations may have yielded items that were arguably more clear than the original items as worded in Appendix J, it is believed that their validity remains intact. As evidence, both experts selected the same objective from a list of 34, and in essence, agreed that the items measured the targeted objective. Also, expert 1 found both items clearly written, suggesting no changes in wording. One last concern raised by expert 2 was the amount of recall required for setting the attributes of the body tags in essay questions 46 and 47. Therefore, the students were supplied with the additional reference material on page 171 for both the posttest and the retention test.

As mentioned previously, items in Appendix E are annotated with the alternative objectives identified by the experts. They were asked to list all possible objectives when they were uncertain which was the target and were asked to list the most appropriate one first. For those items for which both experts listed only the target objective, no alternative objectives are noted. This information is summarized in Table 5.

Each expert was asked to identify the target objective for 69 items, so together they classified 138. In 114 cases, both experts selected the objective targeted by the item. In the other 24 cases, they either listed additional or alternative objectives. In 14 of the 24, the target objective was in the list identified and was actually listed first 8 times. In 5 of the remaining 10 cases, the experts agreed on the objective category, but not on the specific facet of the objective. For example, item 14 was written to measure objective 5b, but the experts both felt it measured 5a. A similar condition held for items 18, 28, and 29. For the final 5 items, the experts identified alternative objective categories, and in all cases, objective 4a was involved. Because of the general nature of this objective, which was to "use tags and attributes correctly," it is not surprising that it might be confused with the other objectives. In fact, expert 2 wrote, "objective 4a relates to almost all of these questions."

In conclusion, none of the suggestions made by the experts differed substantially from the final form of the instruments. Likewise, identified objectives and tar-

Table 5. Summary of Alternative Objectives Identified by Experts

Item[a]	Objective T[b]	Ex1[c]	Ex2[d]
2	1b		4a
8	4a		3c, 4a
9	4a	4a, 5a	3c, 4a
10	4a	5a, 4a	5a, 3c
14	5b	5a	5a
18	6a		6b
28	8a	8a, 8b	8d
29	8a	8b	8b, 8a
36	9b		4a
46_{5}	4a		4d, 4a
46_{6}	4d		4d, 4a
46_{10}	3a		3a, 4a
46_{12}	3a	4a	3a, 4a
47_{5}	4a		4d, 4a
47_{6}	4d		4d, 4a
47_{10}	3a		3a, 4a
47_{12}	3a	4a	3a, 4a

Note. Blank entries indicate those items for which an expert's judgment with respect to the objective measured agreed with the target objective.

[a]Based on item ordering in Appendix E. Subscripts indicate item number with respect to order of appearance on rubric. [b]Target objective. [c]Objective selected by first expert. [d]Objective selected by second expert.

get objectives were in close agreement. Therefore, the content of the achievement measures appeared valid. Concurrent validity was considered next. It seemed reasonable to expect that posttest and retention test scores would correlate positively with each other and with assignment scores. In particular, it was anticipated that the correlations with respect to assignment scores would be highest for the essay portions of the achievement measures, because all of these items measured performance and the application of knowledge. Furthermore, correlations between pilot study assignment scores and pilot posttest essay question scores were statistically significant[15].

As anticipated, scores on the posttest and the retention test correlated significantly with scores on the assignments. This held for the multiple choice and essay portions separately as well as for the measures overall, and in all cases, the correlation between the assignment scores and the essay portions of the exams was greater than or equal to the correlation with the multiple choice portions. In addition, all individual portions of the posttest correlated significantly with all individual portions of the retention test as did the tests in their entirety. All (sub)measures, excluding the pretest, also correlated significantly with scores on EdTech's Exam 1 as well as with the students' final class grades. See Table 6 for a summary of the correlations between achievement and performance scores. Notice that the pretest did not correlate significantly with any item except the multiple choice portion of the retention test ($r = .16$, $p = .04$). However, even for this case, the correlation was small and no linear relationship was readily apparent from an examination of the scatter plot. Because both the pretest and retention test contained the exact same multiple choice items, this was likely just an artifact of students guessing in a consistent manner on items they did not know.

3.4.1.4 Reliability. Based on the 26 multiple choice items and 9 essay items include from the pilot posttest in the measures for the actual study, it was anticipated that the measures for the actual study would be reasonably reliable. For the pilot data, Cronbach's alpha was .72 and intrarater[16] reliability on the essay questions was $r = .96$ ($p < .0001$). In fact, with the exception of the pretest, all achievement measures used in the actual study had moderately high reliability with $\alpha = .89$ for the posttest, $\alpha = .85$ for the retention test, and $\alpha = .87$ for the assignment scores when bonuses and penalties were applied.

The low reliability of the pretest was likely due to the fact that most students knew little about HTML when they took it. On average, they reported that their prior

[15] Recall that the pilot essay questions were rated twice. For the first rating, the correlation between assignment and essay scores was $r = .57$ with $p = .04$. For the second rating, $r = .64$ with $p = .02$.

[16] This was calculated by comparing the scores obtained by grading all essay items on one day and then again on the next day.

Table 6. Correlations Between Achievement and Assignment Scores

		2			3			4		5	
Measure	1	a	b	c	a	b	c	a	b	a	b
1. Pretest	.01	.09	-.01	.02	.16	.06	.10	-.01	-.05	-.02	-.04
2. Posttest											
a. Multiple Choice		.80	.78	.88	.66	.70	.76	.58	.61	.44	.55
b. Essay			.88	.98	.63	.83	.84	.63	.61	.37	.55
c. Overall				.89	.67	.83	.85	.64	.64	.41	.57
3. Retention Test											
a. Multiple Choice					.54	.62	.84	.42	.44	.41	.46
b. Essay						.85	.95	.55	.55	.29	.53
c. Overall							.85	.55	.57	.37	.55
4. Assignment Grade											
a. Bonus/Penalty								.87	.89	.26	.53
b. No Bonus/Penalty									.86	.23	.54
5. EdTech Grades											
a. Exam 1										—	.42
b. Final Grade											—

Note. Values along the diagonal represent Cronbach's alpha for the given measure. Dashes indicate measures for which data needed to perform the calculations were not available. All correlations except those with the pretest and with Exam 1 were statistically significant with $p <= .0001$. For Exam 1, they were statistically significant with $p <= .014$. The pretest was significantly correlated with the multiple choice portion of the retention test only ($p = .0421$).

Table 7. Reported Prior Experience by Treatment

Treatment	n	M	Min	Max	Skewness	Kurtosis
			HTML and LaTeX			
R	48	1.52	1	4	1.37	1.08
C	47	1.62	1	5	1.82	2.53
A	41	1.35	1	3	1.74	2.21
			Programming			
R	48	1.39	1	4	1.93	3.65
C	47	1.45	1	5	2.30	5.04
A	41	1.16	1	3	3.05	10.15

Note. Values were calculated after the scores of individuals in study groups identified prior to the treatment interval were replaced with averages and after missing values were rectified.

experience consisted of less than one year of programming and using formatting languages such as HTML and LaTeX. See Appendix F for the exact wording of the questions and the possible responses. Although a few students in each group reported much greater levels of prior experience in these areas, they were fairly well distributed across treatments. Table 7 lists the average levels of prior experience reported on the pretest and provides additional evidence that prior experience was roughly equivalent across groups, with students in R and C reporting slightly more prior experience than students in A. Recall that, because pretest data were so unreliable and because random assignment appeared to have produced roughly equivalent groups according to the results from several randomization tests, the pretest was excluded from formal data analysis.

In addition to measuring the internal consistency of the instruments, intrarater reliability was calculated for the essay portions of the posttest and retention test. The essays were graded by hand according to the rubrics listed in Tables 46 and 47. Both were graded by a single grader, reducing TA workload and eliminating interrater differences as well as the need to train several TAs on using the rubrics. Rubric checkboxes on pages 196 and 203 facilitated grading by making it easier to remember and check off each of the rubrics. Before grading, 15 students were selected randomly, and their essays were removed from the ungraded stack and photocopied. Then each original and photocopy was returned to a random location in the stack. They were placed throughout the entire stack, so as to account for any potential effects of grading order. Essays for the same 15 students were treated in like manner for both the posttest and retention test, with the exception of student #283 who was missing retention test data. Intrarater reliability for the posttest and retention test, respectively, was $r = 0.99$ and $r = 1.00$ with $p < .0001$.

3.4.2 Student Pacing Preference

Searching the latest Mental Measurements Yearbook via SPIRS (SilverPlatter, 2001) with the search string [(prefer OR preference) AND (pace OR pacing)] yielded four records. Only one, the *Productivity Environmental Preference Survey*, measured something close to pacing preference. The subscore, *Learning Alone-Peer-Oriented Learner*, is 1 of 20 subscores derived from this 100 item instrument. Presumably around 5 items are devoted to this subscore, which ascertains a learner's preference for working individually versus in a group. Reviewers of the PEPS instrument indicate that construct and predictive validity for the measure are not adequately addressed. In addition, reported reliabilities for several of the subscores are low, with 5 under .50, 1 in [.50, .60), 7 in [.60, .80], and 7 in (.80, .90). Because of the unknown validity and possibly low reliability of the PEPS subscores and the fact that self-pacing encompasses more than the single component of working alone versus in a group[17], a new instrument was developed for the current study (see Appendix K). It incorporated features like the ones listed below, which distinguish self-pacing from teacher-pacing.

- Live lecture versus prerecorded lecture
- Learning in a large group versus a small group (possibly of size 1)
- Learning during structured class time each week versus flexible, self-determined times
- Immediate, first-hand access to all students' questions and answers versus deferred, second-hand access to select, frequently asked questions and answers
- One 1-hour lecture versus six 10-minute lectures
- Teacher set deadlines versus student set deadlines
- More frequent self-evaluation versus less frequent teacher-evaluation

Students indicated their preference on a rating scale from 1 to 5 on such issues by responding to the eight questions on the instrument. For four of the items, a response of 5 indicated a high preference for self-pacing. For the other four, it indicated a high preference for teacher-pacing. For all questions, one of the options was always *No Preference*. This instrument was given to the students in class when they took the HTML posttest. As was the case for the pretest, students

[17] In fact, students under self-pacing conditions still have the option of forming study groups, if desired.

were compensated for their time in taking the survey with five extra credit points applied toward EdTech. They also were informed of the importance and *functional* anonymity of their responses. For precise wording, please see Appendix K.

It should be noted that the feasibility of giving a similar instrument prior to treatment was considered. It would have provided a means of determining any changes in self-reported pacing preference that might have been caused by the treatments. However, it might also have sensitized students to the issue of self-pacing versus teacher-pacing, and may even have prompted some of these preservice teachers to learn more about these instructional paradigms. This sensitization, in turn, might have caused students to respond differently to the instrument on pacing preference given after exposure to treatments (Ary, Jacobs, & Razavieh, 1996). There was also the danger that a pretreatment survey might interact with the treatment, decreasing the external validity of the findings. Because of these dangers and the fact that, with respect to pacing preference, the main focus of the current study was to determine whether or not there was a difference between groups following exposure to treatment conditions, rather than whether or not there was a change in preference due to exposure, a pretreatment survey was not administered. In addition, it was assumed that random assignment with more than 30 data points per group adequately distributed students with various initial preferences across groups (Ary et al., 1996).

3.4.2.1 Validity. The construct validity of this instrument was evaluated by two independent experts who had experience using both teacher-pacing and student-pacing instructional paradigms. They were each given the letter in Appendix L as well as copies of tentative pretreatment and posttreatment surveys. Details regarding their evaluations of the pretreatment instrument are omitted, because it was not used. However, one comment by expert 2 had bearing on the posttreatment measure. The expert questioned whether or not it made sense to force a response to an item measuring pacing preference in general. Because the purpose of the posttreatment instrument was to determine whether or not there was a *difference* between groups with respect to pacing preference following exposure to treatments, rather than to determine the nature of that preference, responses were not forced for any of the eight items.

In evaluating how comprehensively the list of features identified in Appendix L distinguished between teacher-pacing and self-pacing, expert 1 found it complete and recommended no changes. However, expert 2 felt it was unnecessary for students to be able to access each others' questions and answers online and recommended the alternative wording of the fourth feature listed in section 3.4.2. Expert 2 also recommended the inclusion of the seventh feature. This prompted the creation of item 7 on the survey instrument (see Appendix K). Other recommendations by expert 2 prompted additional changes to the instrument. Initially, it contained two items measuring the first feature listed in section 3.4.2. These were combined to produce item 1 on the survey. In addition, four items measuring the second feature were reduced to item 2 on the survey. Finally, the word *online* was removed from item 4.

For each item on the instrument, both experts agreed on which end of the rating scale represented a preference for self-pacing with the opposite end representing a preference for teacher-pacing. Again, expert 1 found the list of features measured by the items comprehensive, and an item was added to cover the additional feature recommended by expert 2. Therefore, the final instrument was assumed to possess adequate construct validity.

3.4.2.2 Reliability. This instrument had sufficient reliability ($\alpha = .55$) given that scores were used for research purposes only (Ary et al., 1996).

3.4.3 Level of Procrastination

To procrastinate is simply to delay beginning a task. There are many reasons a student might procrastinate, including having a lack of discipline, assigning lower priority to the task than to other competing tasks, or wishing to increase the challenge of the task by shortening the time frame in which it must be completed. Recall that possible negative consequences of student procrastination include increased workload for graders at the end of the term, increased administrative hassles when students request special consideration for late work, and lower long term recall of acquired knowledge. In order to investigate any differential effects of procrastination for students in different treatments, it was necessary to ensure that procrastination itself differed by treatment. Although the literature supports the expectation that students in R would procrastinate more, quantitative data along two dimensions were collected in an attempt to verify the fulfillment of this prediction.

First, because assignments were submitted electronically, it was an easy matter to log the exact submission date of each one. The timestamp for a given submission was compared with the assignment's due date, d, and a relative value indicating the direction and level of digression from d was recorded. If an assignment was submitted prior to its d, a negative integer was recorded. For example, if it was submitted two days early, then -2 was recorded. If it was submitted one day late, +1 was recorded. If it was submitted on d, 0 was recorded. As mentioned in section 3.2.2, if the assignment was never submitted, then the day after the study ended, s, was taken as the submission date and a value of $s - d$ was recorded. The higher the recorded value, the higher the level of procrastination, as measured by the relative digression from the target response rate. Call this measure the rate of RDTR.

Using the RDTR measure to quantify differences in procrastination level is obviously preferable to failing to report any observable differences (Hobbs, 1981). Of the numerous measures that have been used to characterize procrastination, none appear to distinguish between response patterns as well as the rate of RDTR. In contrast to other measures, the rate of RDTR provides an indication of a student's varying response rate for each task over the entire treatment interval. Some researchers have only considered a subset of course tasks such as delay in completing the first unit test (Lamwers & Jazwinski, 1989) and early completion of the last review exam (Roberts & Semb, 1990, 1989; Roberts et al., 1988). Others have only considered a portion of the treatment interval like the number of tasks completed in the first 6 of 10 weeks (Lamwers & Jazwinski, 1989) and quarter-life[18] (Robin & Graham, 1974). Of those researchers who did consider all tasks completed during the entire treatment interval, most discretized the interval into units. Some used single unit measures that spanned the entire interval such as the average number of submissions per week (Bufford, 1976; Robin & Graham, 1974). Others used multiple unit measures to compare changing work distributions over time. For example, one group compared the average number of daily submissions during three portions of the course (Miller et al., 1974), another examined the distribution of average weekly submissions (Powers et al., 1973), a third examined the distribution of submissions during the first four of five 15-day periods (Morris et al., 1978), and a fourth compared the average inter-quiz interval[19] for the first half of the course with the second half (Sweeney et al., 1979). Some researchers chose to discretize response types into a limited number of categories. For example, students were partitioned into groups consisting of those who completed 12 lessons in 9 weeks versus 12 weeks (Wesp, 1986), those who responded at or above the uniform response line versus those who did not (Wesp & Ford, 1982), and those whose rates were considered accelerated[20], uniform [21], scalloped [22], and/or delayed[23] (Murdock, 2000; Glick & Semb, 1978b; Reiser, 1977). The rate of RDTR does not attenuate differences by discretizing either the interval or the response. It

[18] Quarter-life is calculated by dividing the length of time it took to complete one quarter of the first attempts at unit tests by the total time interval over which first attempts were made.

[19] The number of days between the mastery of a given unit test and the first attempt at the following one.

[20] Glick and Semb (1978b) define this as the completion of two-thirds or more of the work above the uniform response line, while Murdock (2000) defines it as completing one-half or more of the work above the line.

[21] Submissions approximate the uniform response line.

[22] Glick and Semb (1978b) define this as having, "on at least one occasion, completed three course tasks on three consecutive class days" (p. 133), while Murdock (2000) and Reiser (1977) define it as a pause in responding.

[23] Half or more of the tasks are completed below the uniform response line.

yields a continuous, quantitative value that incorporates both negative and positive responses in one measure. Other researchers that have considered continuous values have used measures that focus on undesirable responses or desirable responses separately. For example, some counted the number of days in daily testing (Roberts & Semb, 1990, 1989) and the number of missed deadlines (Roberts & Semb, 1990, 1989), while others counted the number of tasks completed above the uniform response line (Roberts & Semb, 1990, 1989). The rate of RDTR is also easier to interpret and compare across treatments than are visual inspections of graphs of time spent studying (Mawhinney et al., 1971), submissions (Ross & McBean, 1995; Lloyd & Zylla, 1981; Welsh et al., 1980), and attendance (Lu, 1976). Another advantage of the proposed measure is that it readily distinguishes those students who submit fewer assignments from those who submit more. For example, the average number of submissions per week[24], as calculated by Robin and Graham (1974), is the same for a student who submitted one assignment per week for two weeks as for a student who submitted one per week for four weeks. According to the RDTR measure, the latter student would have a preferable lower value.

It should be noted that the rate of RDTR is really a function of the date the assignment was started (perhaps a better measure of procrastination) and of how difficult the student found it. Using this measure, it is possible that an alternative scenario could explain why an assignment was late even though the student did not procrastinate. This would be the case for a student who started an assignment early, intending to complete it before the due date, but found that it was more difficult than anticipated and ended up turning it in late. A more direct measure would have been to ask students to report when they started each assignment. However, there was concern that this would yield incomplete and less accurate data. Also, it seemed reasonable to assume that, for any given assignment, the treatment condition would not correlate significantly with the difficulty level of the assignment, but that the treatment condition would correlate significantly with the date the student started it. If so, then any differential levels in procrastination should reflect a difference in start dates due to treatment conditions.

Additional evidence of higher procrastination levels was collected by tracking the number of student requests for deadline extensions. Such requests were not honored during the treatment interval, so as to ensure the integrity of the study. The TAs were asked to record which students requested deadline extensions and for which assignments they requested them. *After* the treatment interval, reasons given for requests were reviewed along with scores for the students who reported experiencing technical difficulties. Students who reported having corrupt CD-ROMs were required to bring them back in exchange for new ones. All of the

[24]Robin and Graham (1974) actually called this “rate of first takes” in reference to the required mastery of unit quizzes.

eight exchanged CD-ROMs were tested. Only three, all from students in A, were found to be corrupt. The other five, with three from students in C and two from students in R, were not found to be defective. Thus, penalty points for late submissions were lifted for the students in A only, and these students were removed from formal data analysis. Penalty points were also lifted for the student whose name contained punctuation which was not handled properly by the assignment submission scripts. Finally, penalty points also were lifted for a student who submitted two assignments directly via e-mail by their respective due dates, rather than via the online submission forms. None of the other requests for special consideration were honored.

3.4.3.1 Validity. The validity of these measures was scrutinized by the same two experts who reviewed the achievement and preference measures. Both agreed that average days late on assignments per student and average number of requests for extensions per student were sufficient in determining procrastination level. Neither suggested the inclusion of any other indicators. Therefore, the measures appear to possess face validity, at least, with respect to student procrastination level.

3.4.3.2 Reliability. Of the two indicators, it was anticipated that the one based on submission dates would indicate the level of procrastination best. Values were highly reliable, because they were calculated automatically when assignments were submitted electronically. In order to ensure that no errors were introduced due to problems in the software used to log submissions and to register bonuses and penalties, the software was tested before and during the treatment interval. Each assignment was submitted several times under fictitious names on various dates. For example, assignment 5 was due on March 10, so test data were submitted on March 6, 10, 13, 14, and 25 for this assignment for all three treatments to make sure that bonuses and penalties were registered and applied appropriately in all cases. Similar tests, conducted for all assignments, verified that that the submission and grading software worked correctly. Only one student experienced software-related problems in submitting assignments because of name punctuation. Also, the Web server used for the study was monitored continuously during the treatment interval and found to be available to handle submissions with no lapse in service.

In order to facilitate the reporting of requests for deadline extensions, the courseware supplied to the TAs included convenient, password-protected access to the form in Figure 10. Although these data were subject to error in that the TAs might have forgotten to enter requests in some cases, it was assumed that the distribution of such errors was roughly equivalent across treatments. This would have been the case even if one TA had forgotten to enter all requests, because each TA had about the same number of students in each condition. Therefore, although

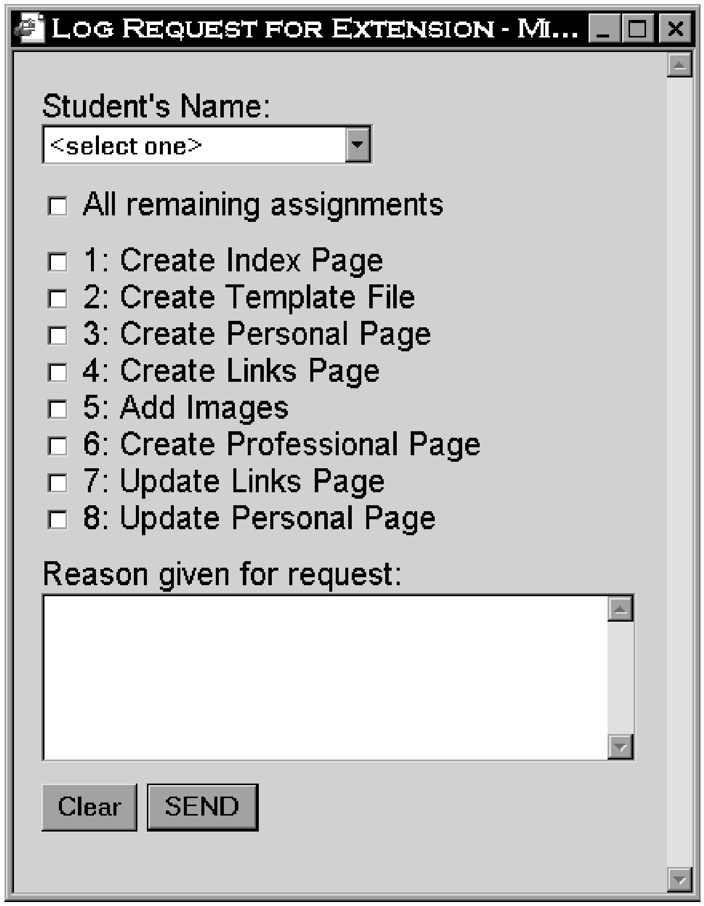


Figure 10. Form used to log requests for deadline extensions.

these data were less reliable than the data based on submission date, they were maintained for analysis.

3.4.4 Assignment Scores

In the courseware, students were told explicitly that they could work on assignments together if desired. This information was given with the caveat that they would be required to write HTML code on the posttest. They were warned that if they worked too closely with others and did not make sure to understand the material themselves, it was very likely that they would earn a much lower score on the posttest. Because the students had the freedom to collaborate on the assignments, assignment grades were extremely likely to be dependent. Although, on average, students reported (see Appendix P) collaborating with fellow classmates on the assignments only 22% of the time, and that they did 72% of the assignments completely on their own, 41 students (or 25%) indicated that they collaborated on assignments with classmates at least 40% of the time. Considering only those 109 individuals not in self-made study groups, students reported, on average, working with classmates 13% of the time and that they completed 77% of the assignments alone. However, 17 (or 16%) did report collaborating at least 40% of the time. Both sets of students reported, on average, that they rarely received help from either the course officials or any other outside sources. Still, the likelihood of dependent assignment grades and the fact that ANOVA and MANOVA are very sensitive to violations of this assumption, meant that such methods of analysis were not tenable. Note that this dependence also might be reflected in the achievement, preference, and procrastination scores, albeit to a lesser extent. Implications for data analysis are discussed in chapter 4.

It should be noted that 4 of the individuals in study groups reported having completed more assignments on their own than they actually submitted, as did 14 of the individuals not in study groups. Distributed in roughly equal numbers across all treatments, 7 students were in R, 6 were in C, and 5 in A. Reported values might be inflated for any number of reasons. Students may have completed certain assignments after they were due, and so, did not bother submitting them. Because the instrument used to gather this information was not anonymous, they might have felt the need to over report a little. Of more concern, the online submission tools might not have logged all submissions correctly. However, this latter explanation is less likely, because the likelihood that all 18 students failed to notice a reduction in their posted grades and report it was very small. Whatever the reason, this over reporting does raise doubt about the accuracy of the data garnered with this self-report instrument.

In any case, the assignment scores themselves still were valuable. For example, statistically significant correlations between them and the achievement scores provided evidence of the concurrent validity of the latter. Also, they were a performance-based measure that accounted for 60% of the students' grades in the HTML portion of EdTech. A brief discussion of the reliability and face validity, at least, of the assignment scores seems appropriate.

There were eight assignments. The goal of the first two was to acquaint students with the development process as specified in objectives 1-2 (see Appendix D), so they were given the HTML source code. The goals of assignments 3-8 were aligned closely with objectives 5-10, respectively. Objectives 3-4 were more general and implicitly included in all assignments. For a more detailed description of each assignment, see Appendix C. For assignment details provided on the accompanying CD-ROM, see Appendix U.

Students submitted assignments by first clicking the appropriate *Submit* button in the assignment list provided with the courseware (see Figure 3). Then they filled in a form like the one in Figure 11 to gain access to the submission software. Next, they pasted their HTML source code into a form like the one in Figure 12. Finally,

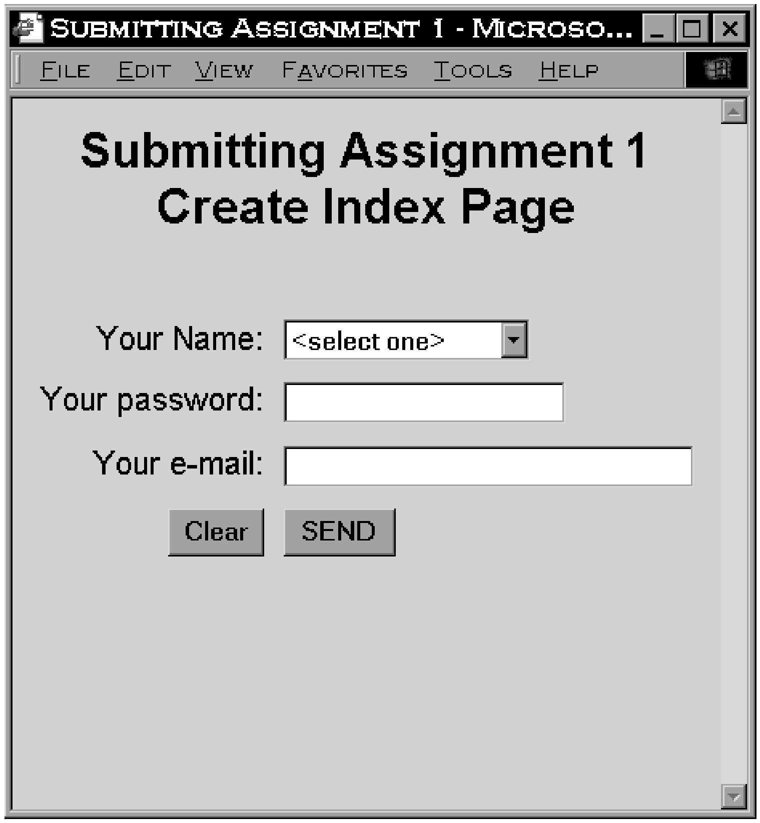


Figure 11. Form used by students to access submission software.

they received a confirmation message online like the one in Figure 13 as well as via e-mail. E-mailed confirmations included their name, the exact date of their submission, and a complete copy of the source code received. All assignment information was maintained in a database with restricted access. TAs were not able to jeopardize the study by allowing students to submit work late for credit.

TAs graded assignments using online, password-protected tools, which they were able to access conveniently from links included with their version of the courseware. After indicating their identity using the form in Figure 14, they were supplied with a form similar to the one in Figure 15, which contained a list of students whose assignments had yet to be graded. After selecting one of the assignments, say the first one, they were given a form containing the assignment rubrics like the one in Figure 16. Also, another browser window was opened, containing the student's work (see Figure 17). They had the option in the rubrics window of either clicking on the checkboxes to the left of those rubrics the student fulfilled, or clicking directly on the graphical representation of the rubrics. Clicking on the checkmarks in the graphic on the left, caused checkmarks to be entered into the rubric boxes on the right. Clicking on the x's in the graphic caused the checkmarks to be removed. TAs also had the option of filling in a personal message in the

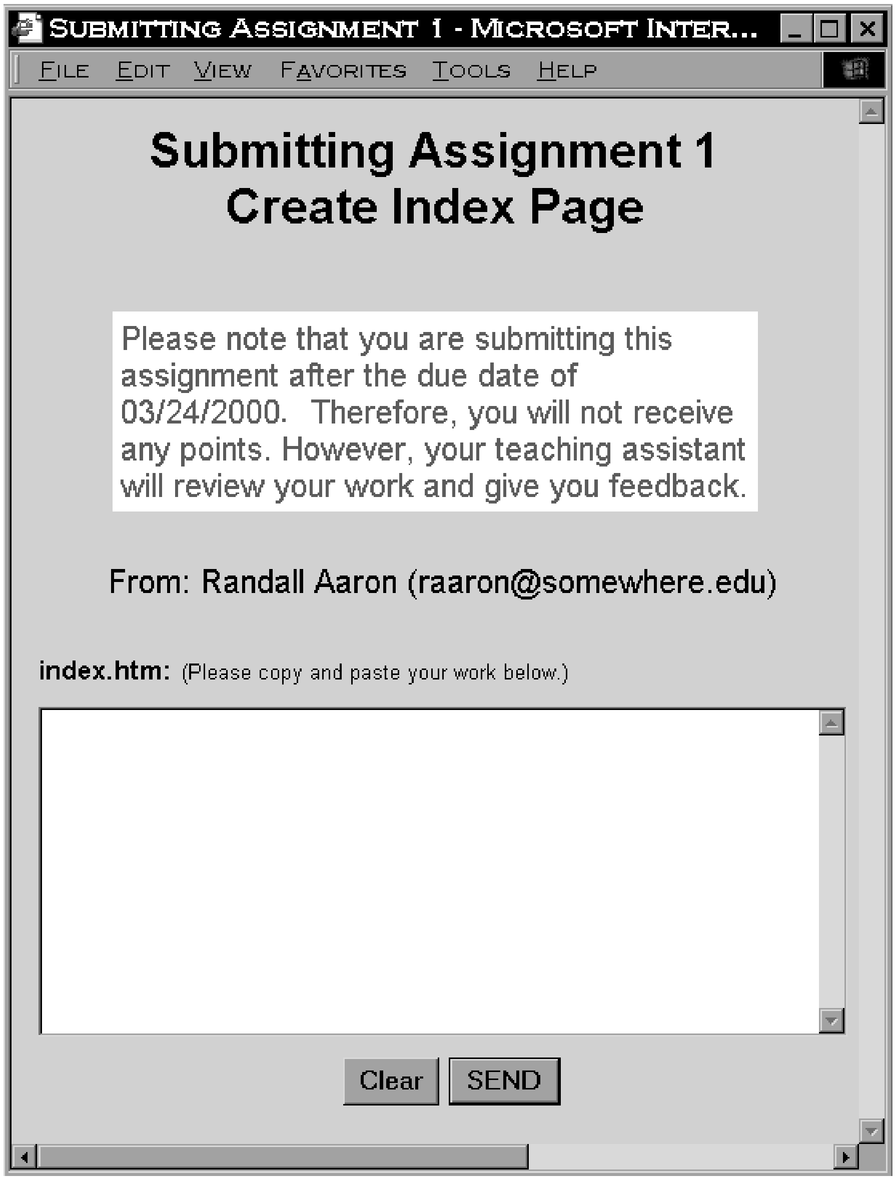


Figure 12. Form used by students to submit assignments.

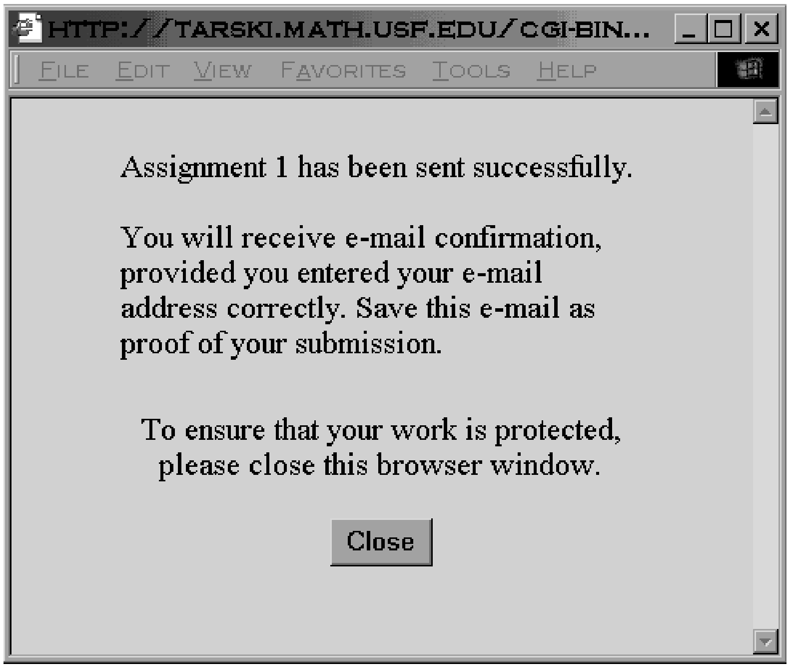


Figure 13. Confirmation message for successful submission.

supplied textbox before clicking the button on the bottom right, which saved the grade on the server and e-mailed a copy to the student. For an example e-mail message sent to a student, see Figure 18. Finally, the TAs could click the link provided with the rubric (see Figure 16), if they wished to view the solution code for the assignment in a third window like the one in Figure 19.

In order to determine the validity of the assignments, an HTML expert was given the letter in Appendix N along with access to all of the online rubrics used by the TAs. For each rubric, the expert indicated which objective category it measured, sometimes listing more than one. If a rubric did not appear to measure any of the objectives, the expert was asked to enter an *N*. Also, after considering all of the rubrics for a given assignment, the expert was asked to list implicit objectives measured by the assignment but not addressed directly by any of the individual rubrics. Based on the expert's responses, each rubric measured at least one of the objectives, and all rubrics were distributed fairly well across all objectives (see Table 8). It is interesting to note that the weighting identified by the expert actually matched the alternative weighting proposed for the posttest and retention test items better than it did the original weighting. In any case, the assignments appear to possess content validity, and correlations between assignment scores and achievement test scores provide evidence of concurrent validity. In addition, the assignment scores were reliable with $\alpha = .87$ after applying bonuses and penalties. Data on interrater reliability were not collected.

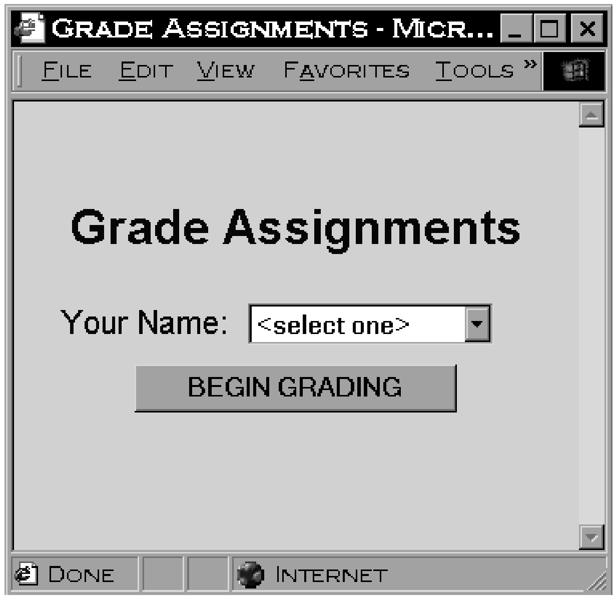
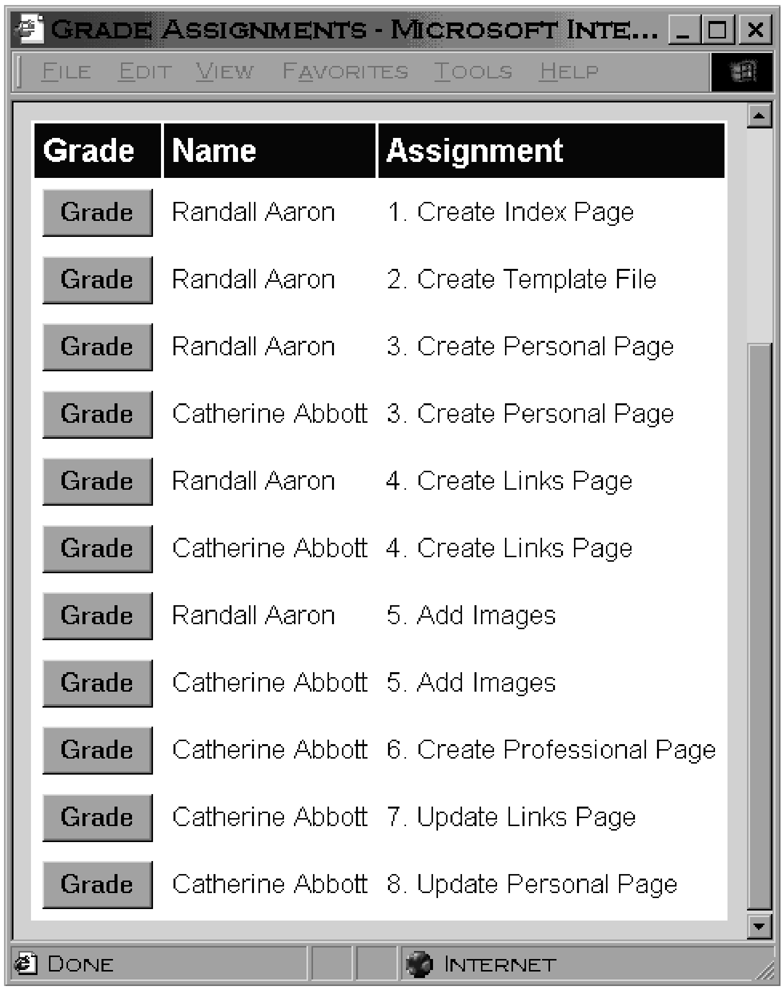


Figure 14. Form used by TAs to access grading software.

Table 8. Objectives Measured by Rubrics and Achievement Items

	Objective									
Measure	1	2	3	4	5	6	7	8	9	10
Assignment Rubrics	6	10	24	23	13	2	9	4	5	5
Posttest Items	2	4	29	26	11	6	6	6	6	6
Retention Test Items	5	5	29	29	10	5	5	5	5	5
Original Weighting	4	6	13	15	10	10	10	10	10	10

Note. All values are given in percentages and rounded to the nearest whole value.



Grade	Name	Assignment
Grade	Randall Aaron	1. Create Index Page
Grade	Randall Aaron	2. Create Template File
Grade	Randall Aaron	3. Create Personal Page
Grade	Catherine Abbott	3. Create Personal Page
Grade	Randall Aaron	4. Create Links Page
Grade	Catherine Abbott	4. Create Links Page
Grade	Randall Aaron	5. Add Images
Grade	Catherine Abbott	5. Add Images
Grade	Catherine Abbott	6. Create Professional Page
Grade	Catherine Abbott	7. Update Links Page
Grade	Catherine Abbott	8. Update Personal Page

Figure 15. List of assignments to be graded for a given TA.

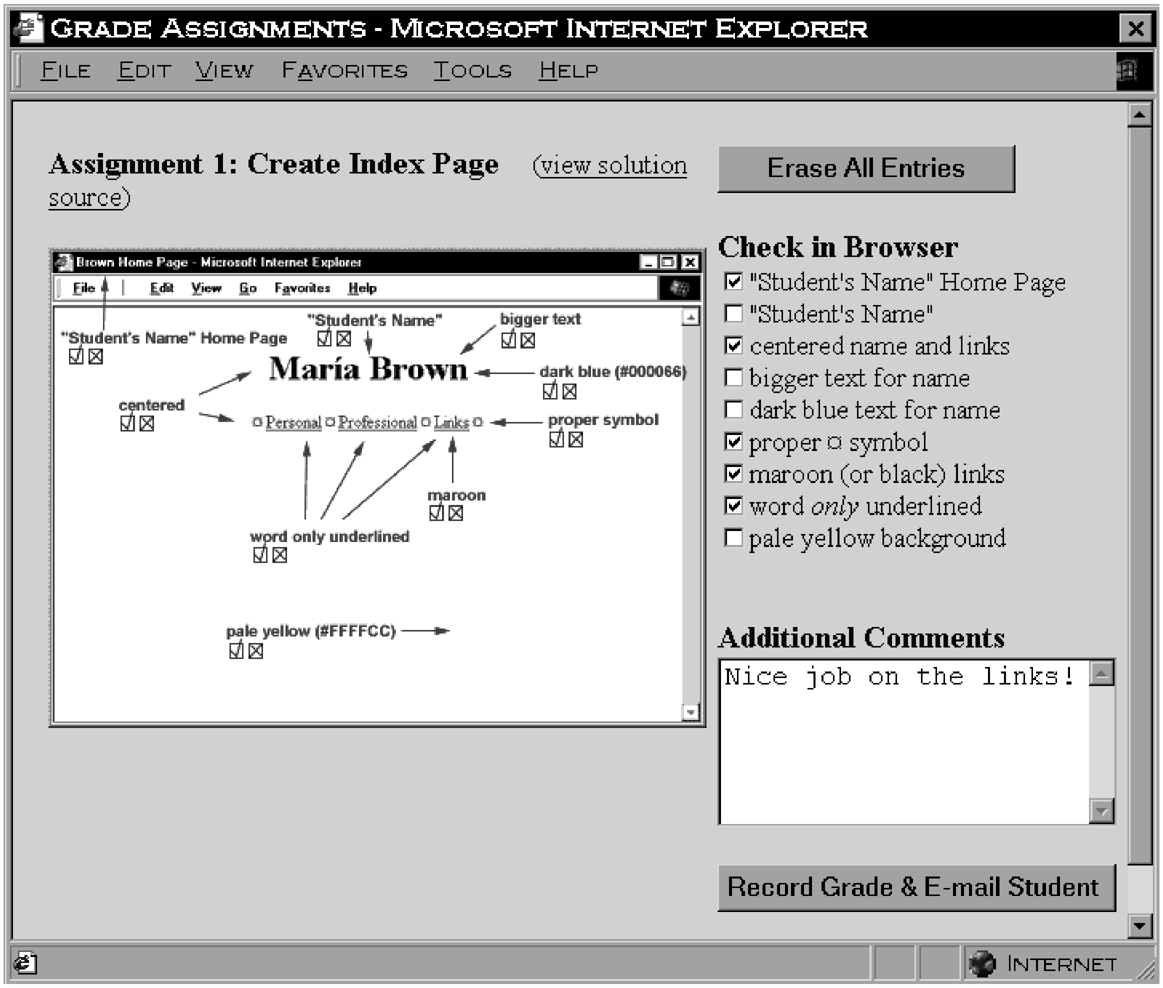


Figure 16. Grading rubric used by TAs for assignment 1.

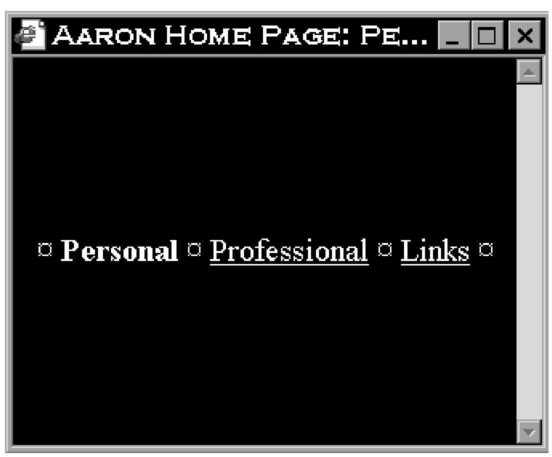


Figure 17. Assignment 1 for a given student.

Subject: RE: Your Grade on Assignment 1

Randall,

You successfully accomplished 5 of 9 items on the grading rubric for this assignment. Therefore, you earned 2 out of 4 points. However, because you turned your work in after 03/24/2000, this assignment is worth no points, and a 0 has been recorded as your grade.

STUDENT :	Randall Aaron
ASSIGNMENT :	1
GRADE RECORDED :	0

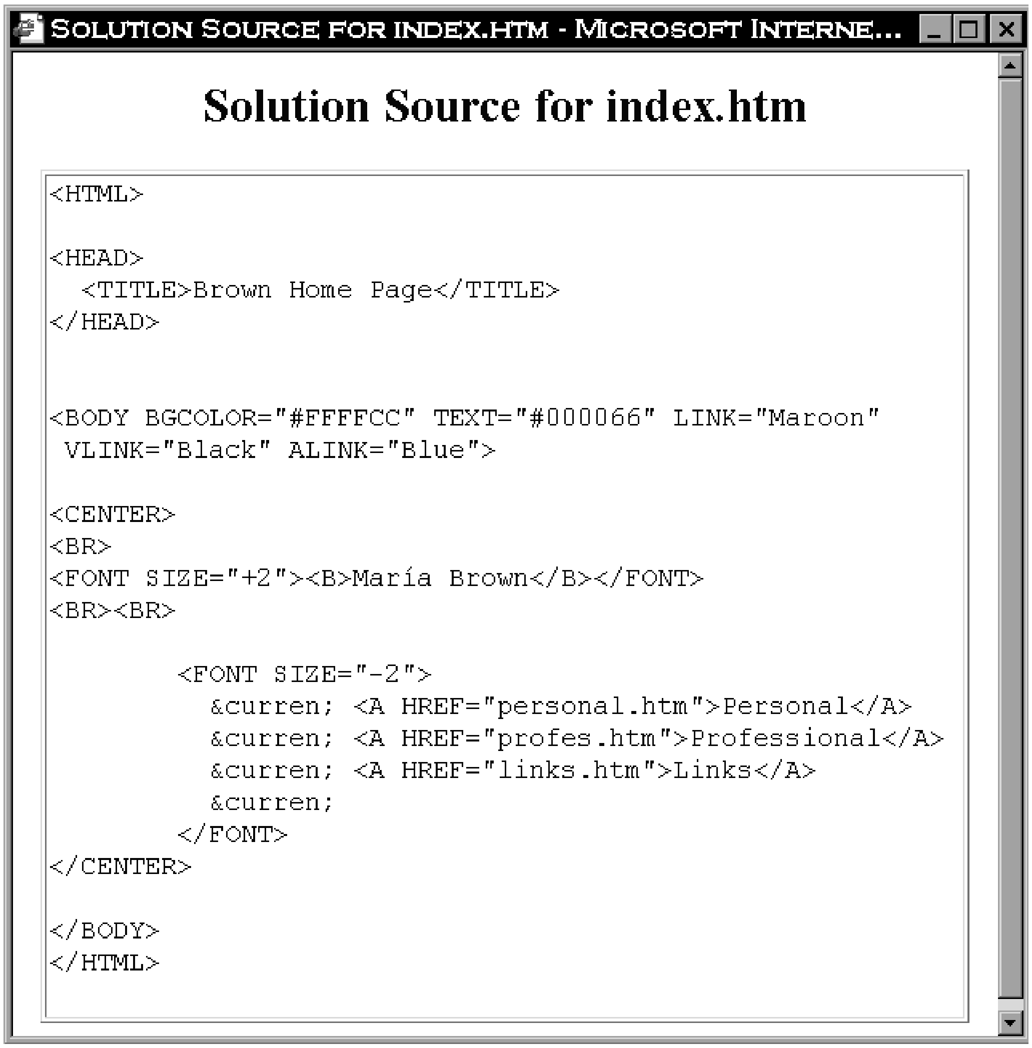
You missed the following items:

- Your name does not appear in the browser window.
- The text for your name is not bigger.
- The text for your name is not dark blue.
- The background color is not pale yellow.

Additional Comments:

Nice job on the links!

Figure 18. Grade e-mailed to student.

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          &curren; <A HREF="profes.htm">Professional</A>
          &curren; <A HREF="links.htm">Links</A>
          &curren;
        </FONT>
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Figure 19. Solution source code for assignment 1.

Chapter 4

Results

Data were analyzed in four phases. First, the reliability of the retention test was estimated based on posttest data and curves were applied to students' HTML grades in order to counter any possible treatment effects on students' grades in EdTech. Next, the pacing preference data were analyzed using ANOVA. Then, randomization tests were used to analyze the procrastination data. In the final phase, achievement data also were analyzed using randomization tests. Because ANOVA is not robust to violations of the independence assumption, steps were taken to reduce the effects of dependence caused by students working together in self-made study groups. As discussed previously, students were asked to report the members of such groups prior to the treatment interval, and members of the same group were all assigned to the same treatment. Following the treatment interval, students were asked again to report the composition of their study groups, and four additional groups were identified. The scores of students in these 22 study groups were averaged prior to analysis with ANOVA. Because randomization tests are most justified when observations are randomly assigned to treatments prior to the treatment interval, only the 18 study groups[1] which informed assignment to treatment conditions were replaced with average scores prior to analyzing the achievement and procrastination data.

4.1 Estimation of Retention Test Reliability and Curving of Grades

The posttest data were analyzed before the retention test was administered. Multiple choice responses were scored automatically, and the essays were rated by hand. As reported in section 3.4.1.4, intrarater reliability for the essay was .99 ($p < .0001$) and Cronbach's alpha was .89 for all 48 items. Considering only those 9 multiple choice items that measured objectives comparable to the ones measured by the items on the retention test, along with the 12 essay items, Cronbach's

[1]There were 19 study groups initially, but both members of group 2 were dropped from the study due to missing data, reducing the number of initial study groups to 18.

alpha was .69 for the original weighting scheme[2] proposed for the retention test and .86 for the adopted alternative weighting scheme in which all items had equal weight. Therefore, it was anticipated that the 21 items on the retention test would possess sufficient reliability and no changes were considered. In fact, α was .85 for the actual retention test and intrarater reliability for the essay portion was 1.00 ($p <$.0001).

During this phase of data analysis, grades[3] for the HTML portion of the course were calculated for each student. Considering only the 58 students in each treatment who had submitted at least one assignment or had taken the posttest, students in R, on average, earned 28.65 points out of 60, students in C earned 26.96 points, and students in A earned 20.28 points. Because differences in these average scores might have been due to assignment to a particular treatment, 2 points were added to student totals in C and 8 points were added to student totals in A. Next, because the totals were lower than anticipated in general, an 11 point curve was added to all student totals. However, no total was allowed to exceed 60 points. Extra credit was earned only by completing the optional pretest (5 points) and pacing preference survey (5 points). See Table 25 for a listing of student grades before and after applying the curve and extra credit points. Finally, consider only the portion of EdTech's Exam 2 which contained the retention test questions. On average, out of 12 points, students in R earned 4.54, students in C earned 5.17, and students in A earned 4.25. Again, to reduce possible treatment effects on students' grades, 1 point was added to the Exam 2 scores for each student in groups R and A.

4.2 Analysis of Pacing Preference Data

The second phase of data analysis focused on the pacing preference data collected on March 28. The goal of each question was to determine the student's preference for teacher-pacing versus student-pacing. For half of the items a response of 1 represented the highest preference for self-pacing. For the other half, a response of 5 indicated such a preference. The direction of the scale for each item was determined randomly. The purpose of this inversion was to reduce the bias of the instrument and to make it easy to detect any response patterns that might indicate each question was not considered thoughtfully. Because no students reported all ones or all fives, all responses were retained for analysis.

[2]Recall that essay items were entered as either 0 (incorrect) or .25 (correct) under this scheme.

[3]For grading purposes, posttest and retention test averages were calculated based on the original weighting schemes proposed.

Table 9. Descriptive Statistics for Pacing Preference Data

Treatment	*n*	*M*	*SD*	Skewness	Kurtosis	Min	Max
R	46	2.81	0.64	0.77	0.68	1.62	4.50
C	45	2.82	0.59	0.14	-0.54	1.75	4.12
A	40	2.80	0.58	0.43	0.68	1.62	4.50

The rating scale employed yielded roughly interval data with $\alpha = .55$. Therefore, it was reasonable to calculate an average score for all eight responses, after inverting items 3, 5, 6, and 7. Notice that the lower the average score, the higher the student's preference for teacher-pacing. See Table 24 for a listing of responses prior to inversion and Table 25 for a listing of average scores. Stem-and-leaf plots for the scores in each group appeared unimodal, and descriptive statistics (see Table 9) gave further evidence of roughly normal distributions with skewness values in [.14, .77] and kurtosis values in [-0.54, .68]. Groups appeared to have equal variance. However, the independence assumption may have been violated, because students were allowed to work on assignments together. Working with fellow students under conditions of self-pacing may have caused students in the same study group to form similar opinions about this teaching paradigm, so as mentioned previously, scores for students in study groups were averaged in an attempt to mitigate such effects.

There were no z scores greater than or equal to three, and hence, no values considered to be potential outliers. As anticipated, pacing preference did not differ significantly across treatments ($F(2,128) = 0.02$). This, coupled with an effect size of 0.02, indicated that any treatment effect was small at best and that differences in preference were of neither statistical nor practical significance.

4.3 Analysis of Procrastination Data

The procrastination data were to be analyzed using MANOVA. However, the variable measuring the number of requests for deadline extensions, call it x_1, was extremely leptokurtic and positively skewed with kurtosis values in [12.57, 40.45] and skewness values in [3.48, 6.26] for the treatment samples. Out of 131 data points, only 11 had nonzero entries for x_1. Therefore, it was not included in any parametric analyses. Nonparametric procedures such as the chi-square test for independence also were not appropriate with so few nonzero entries. Although no definitive conclusions can be drawn, it is interesting to note that two students in R requested extensions as did five in C and four in A. Now, consider the RDTR, which measured the average amount of procrastination of each data point for all eight assignments, and call it x_2. Because the univariate normality of each of the

Table 10. Descriptive Statistics for Procrastination Level Data

Treatment	*n*	*M*	*SD*	Skewness	Kurtosis	Min	Max
All students							
R	48	7.92	6.30	-0.02	-1.08	-5.00	16.75
C	47	3.80	5.39	1.06	0.75	-5.75	16.75
A	41	7.12	6.01	0.49	-1.03	-1.25	16.75
Students who submitted at least one assignment							
R	40	6.15	5.36	0.07	-0.65	-5.00	16.12
C	43	2.60	3.80	0.41	-0.34	-5.75	11.25
A	34	5.13	4.47	0.72	0.21	-1.25	16.12

contributing variables is a necessary condition of multivariate normality (Stevens, 1986) and because of the radical departure from normality of x_1, the condition of multivariate normality with respect to x_1 and x_2 was not met. Although, MANOVA is robust for moderate departures, the lack of normality was extreme in this case. Therefore, MANOVA was not tenable, and ANOVA was considered as the next reasonable option for analyzing x_2.

No potential outliers with *z* scores greater than or equal to three were identified for the sample distributions of x_2. Unfortunately, the platykurtic nature of the distributions for treatments R and A (see top panel of Table 10) meant a reduction in power (Stevens, 1990). A closer inspection of the histograms (see Figure 20) revealed that these values were due, in part, to the fact that a number of students in each treatment submitted no assignments during the treatment interval and had average procrastination levels of 16.75. Considering only those students who submitted at least one assignment, yielded more normal skewness and kurtosis values (see bottom panel of Table 10), although group R was still slightly platykurtic.

Of the 22 individuals who submitted no assignments, 11 were in R, 4 were in C, and 7 were in A. After taking study groups into account, the 11 in R were reduced to 8. These 22 individuals were distributed across all TAs in roughly equal numbers with TAs 1-5 having 4, 4, 3, 7, and 4 of them. Although one might argue that these students did not really participate in the study and that their scores should be removed from analysis, it also was possible that they did actually participate but procrastinated too long to see the value of completing any of the assignments. The fact that the number of such students in each treatment differed gave some evidence in support of this latter theory. Of course, both explanations could be true in part. In any case, knowing that one treatment might cause more students to disengage was deemed valuable information, and it was reasonable that the mean be higher for groups with more such students. In addition, these 22 students were

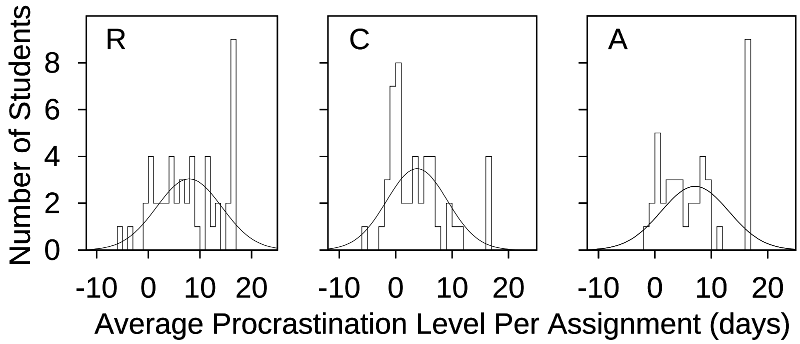

Figure 20. Procrastination histograms. Procrastination level is plotted for all students relative to assignment due dates. A value of -5 indicates that, on average, the student submitted assignments 5 days early. Totals are accumulated based on the next lower whole day. For example, values in the range [1,2) are accumulated in the total for 1. The smooth normal curves provide visual references for determining departures from normality.

not homogeneous with respect to Exam 1 scores in EdTech. On average, students in R earned 47.64 ($SD = 18.34$), students in C earned 29.75 ($SD = 34.41$), and students in A earned 51.43 ($SD = 11.22$). Simply removing this data likely would have impacted the treatments differentially. Therefore, it was retained, and consequently, the normality assumption was likely violated. Because of the reduction in power associated with using ANOVA on platykurtic data (Stevens, 1990), randomization tests were employed.

The randomization model is justified in this case, because observations were randomly assigned to treatments. Rather than rely on a table of F values which assumes that data are normally distributed, randomization tests provide a means of creating a distribution based on the data at hand. It also allows the researcher the freedom "to choose a test statistic that is appropriate for the particular situation being considered." (Manly, 1997, p. 23) First, a reasonable test statistic, say the difference between the means of two groups, is selected and calculated for the original data. Call this calculation s_0. Then the original data are permuted, so that any given observation, which once belonged to one group, may now belong to a different group. The test statistic is then recalculated for this new permutation. The process of permuting the data and recalculating the test statistic continues, so that a distribution of test statistics is built, call it S. After a reasonable number of repetitions, s_0 is compared to the test statistics in S. If the null hypothesis is true, then all permutations of the data should be equally likely and s_0 will be a typical value in S. If that is not the case and s_0 appears to be extreme, then there is evidence that the null hypothesis should be rejected in favor of the alternative. Determining the significance level of s_0 (or its p-value) is simply a matter of calculating what percentage of the values in S are greater than or equal to s_0. In the ideal situation, all possible permutations of the data would be considered. However, even for relatively small N, the total number of permutations is generally too large for modern computers to handle, and so, a reasonable subset of permutations is considered in order to approximate the significance level of s_0. Manly (1997) suggests that, for nominal $\alpha = .05$, test statistics for at least 999 permutations should be calculated, in addition to s_0. For nominal $\alpha = .01$, at least 4999 additional permutations should be considered.

Because the SAS version available at the time this report was written did not contain general purpose functions for running randomization tests that were easily modified to incorporate the test statistics of interest, C code was written to analyze the procrastination data via the randomization model described above. Each function was thoroughly tested as it was written. In addition, the randomization portions of the code were tested using the Vitamin E data set described by Good (2000, p. 4-8). Following Good, the test statistic employed was the sum of the values of the cultures treated with Vitamin E. In agreement with his $s_0 = 349$ and his precisely calculated p-value of .05, the code reported $s_0 = 349$ and closely approximated the p-value at .0502, based on 999999 additional randomizations. The procrastination data were analyzed using alternative test statistics, which are discussed below. To review the actual code, see Appendix S. Also, refer to Appendix U, which describes the material provided on the accompanying CD-ROM.

First, an omnibus test statistic was selected to analyze the 136 data points based on the differences between the means for groups R, C, and A. It was expected that the average procrastination level would be higher for group R ($\overline{P}_r$) than for groups C ($\overline{P}_c$) and A ($\overline{P}_a$), and it was unclear how average levels would be related for groups C and A. Therefore, the omnibus test

$$(\overline{P}_r - \overline{P}_c) + (\overline{P}_r - \overline{P}_a) + \left|\overline{P}_c - \overline{P}_a\right|,$$

which incorporated two one-sided tests and one two-sided test, seemed appropriate. It yielded statistically significant results with $s_0 = 8.23$, $p = .0012$, in favor of the alternative hypothesis that the treatment condition did have a significant effect on procrastination level. Therefore, additional tests were conducted in order to determine which groups differed significantly from one another. To test the hypothesis that the average procrastination level for group R was higher than the average levels for groups C and A, the one-sided test statistics, $\overline{P}_r - \overline{P}_c$ and $\overline{P}_r - \overline{P}_a$, were used. However, because the direction of any difference in levels between groups C and A was uncertain, the two-sided test statistic, $\left|\overline{P}_c - \overline{P}_a\right|$, was used. After applying a Bonferroni adjustment of a factor of three for the three tests considered, the nominal $\alpha = .05$ was adjusted to $\alpha = .017$. The data for the groups being compared were permuted randomly 999999 additional times[4] according to the method proposed by Manly (1997, p. 90) and illustrated in the permute function in Appendix S. Although, the test statistic $\overline{P}_r - \overline{P}_a$ was not significant with $s_0 = 0.80$, $p = .2710$, $\overline{P}_r - \overline{P}_c$ was significant with $s_0 = 4.11$, $p = .0005$ as was $\left|\overline{P}_c - \overline{P}_a\right|$ with $s_0 = 3.31$, $p = .0078$. The effect sizes were $\hat{d} = 0.13$, $\hat{d} = 0.70$, and $\hat{d} = 0.58$, respectively, ranging from quite small to moderately large. Thus, there was some evidence that students in A procrastinated more than students in C and even stronger evidence that students in R procrastinated more than students in C.

Figure 21 illustrates the fact that students in C maintained a more consistent submission rate throughout the treatment interval, while students in R and A submitted less assignments during the interval with steeper increases in submission rates at the end. This scalloped effect was most evident for students in R, whose increase in assignment submission rates between days 27 and 32 gave evidence of their massed learning near the end of the treatment interval. It was also interesting to note that all groups experienced a plateau between days 19 and 27, where lower submission rates coincided with Spring Break. Differences between groups R and C were arguably practical as well, with students in R turning in assignments, on average, about four days (4.12) later than students in C. Similarly, students in A submitted assignments more than three days (3.32) later than students in C. Figure 22 illustrates the fact that this pattern held for all but the last two assignments. Recall that the deadline for these two really was more of an absolute deadline for all groups. No students were allowed to submit any assignments for credit after this final due date, although students in C could still earn bonus points for submitting their work early.

It was expected that procrastination levels would be similar for students in C and A, and that students in R would procrastinate significantly more than students in both C and A. However, group means and Figures 21 and 22 indicate that procrastination levels for A were more similar to R than to C. Although students in A appeared to start out with submission rates more like those of students in C, C and A quickly diverged and rates for A aligned more with rates for R. Figure 23, which illustrates that fewer students in A completed each assignment, provides evidence of a possible explanation. For missing assignment scores, recall that the day after the close of the study was entered as the official submission date. This had the effect of inflating the procrastination levels for students who did not submit their work, and hence, levels were inflated most for students in A. In fact, Figure 24 shows that, when only those assignments actually submitted were considered, procrastination levels were more similar for A and C than for A and R. Still, it was necessary to

[4] A total of 1,000,000 permutations were considered for all randomizations performed in this study in order to obtain p-values with precision to the thousandths place. Comparing p-values obtained for 1,000,000 permutations to those obtained for 2,000,000 permutations yielded fluctuations in the ten-thousandths place only.

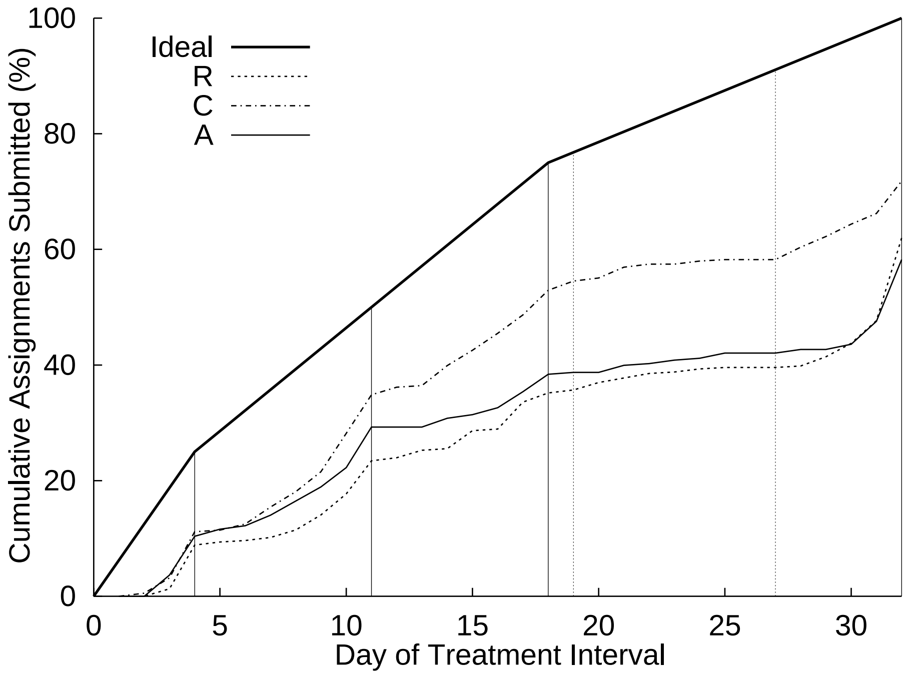

Figure 21. Cumulative percentage of assignments submitted each day. R, C, and A show the submission patterns for the corresponding treatments. Ideal shows the submission pattern expected, if all students would have submitted all assignments steadily over the treatment interval. The four dark, vertical lines represent common due dates across treatments. The two light, vertical lines delimit the start and end of Spring Break.

maintain information about the *number* of assignments submitted by a given student as well as how late they were. Otherwise the procrastination level of a student who submitted only one assignment but turned it in on its due date would be the same as that of a student who submitted all assignments on their respective due dates. Clearly, these two students would differ in the amount and distribution over time of the work they did as well as in how much they learned. Therefore, no alterations were made in the method of handling missing procrastination data.

4.4 Analysis of Achievement Data

As discussed in section 3.4.1.4, because the pretest scores were unreliable, only the posttest and retention test scores were analyzed. The achievement scores were to be analyzed using repeated measures with treatment as a between factor and time as a within factor. However, this analytic approach assumes multivariate normality, which in turn, requires that each of the measures for each of the

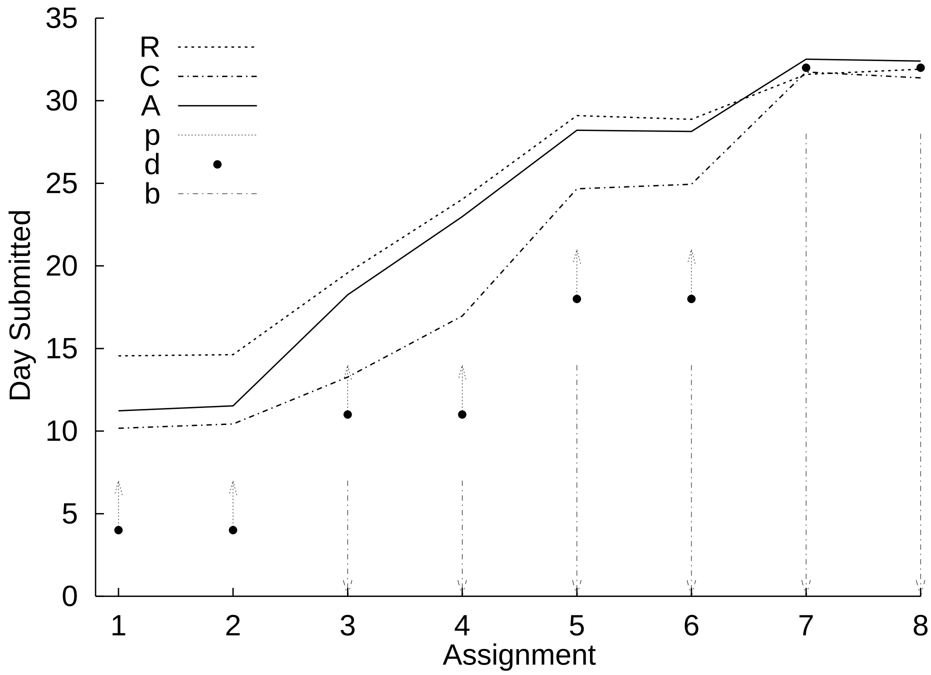

Figure 22. Procrastination level with estimated missing data. Missing assignments were recorded as having been submitted the day after the close of the study, which lasted 32 days. R, C, and A are the treatments, d is the common due date across treatments, and p and b are the penalty and bonus intervals for students in C.

samples be univariate normal. Unfortunately, the descriptive statistics in Table 11 indicate that the distributions of posttest and retention test scores tended to be platykurtic, with three of six kurtosis values less than -0.5. The histograms in Figure 25 illustrate this graphically. Because the univariate normality assumption was likely violated and platykurtosis has been associated with a reduction in power, the achievement scores were analyzed using randomization tests.

In order to determine whether or not there was an interaction between time and treatment, a test statistic was selected based on difference scores, which were calculated by subtracting the posttest scores from the retention test scores for each data point. This yielded scores that were slightly platykurtic for group C and positively skewed and leptokurtic for group A, as evidenced by the descriptive statistics in Table 11 and the histograms in Figure 26. One extreme difference of 47.62 for student #288 in group A accounted for some of the departure from normality. Removing this value yielded a mean of 7.47, standard deviation of 10.01, skewness of 0.43 and kurtosis of 0.65. However, Good (2000) recommends retaining all of the original data in order to avoid reducing the power of the randomization test. Therefore, the data associated with student #288 were not discarded.

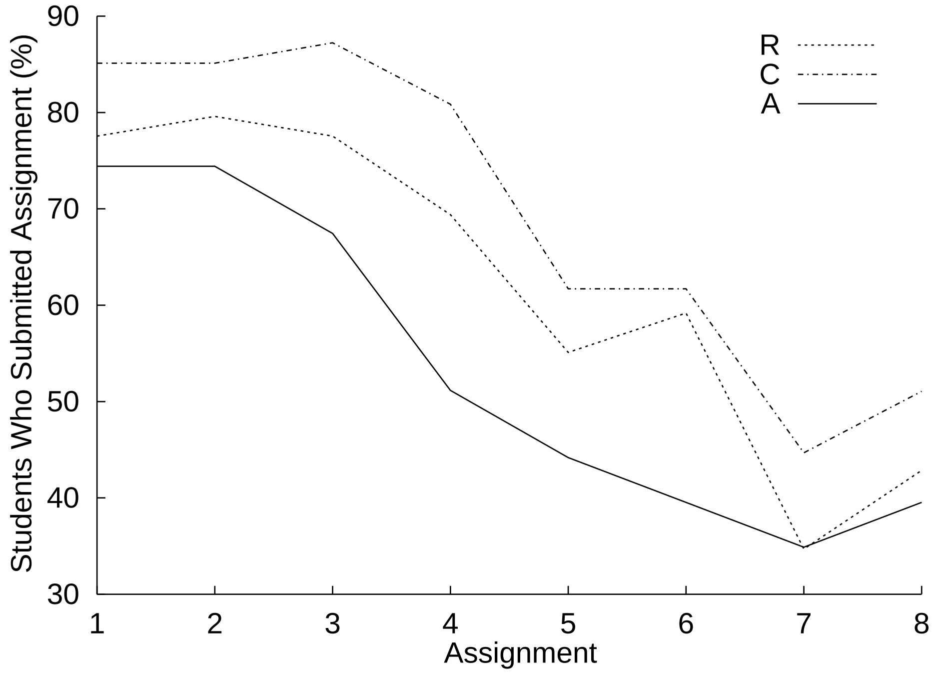

Figure 23. Percentage of students submitting assignments.

Using C code similar to that used for the procrastination data, a randomization test was first used to conduct an omnibus test on the difference scores. Letting $\overline{D}_r$, $\overline{D}_c$, and $\overline{D}_a$ be the mean difference scores for students in groups R, C, and A, respectively, the omnibus test statistic $s = 2\overline{D}_r - 2\overline{D}_c$ was selected based on the following rationale. Because students in group R procrastinated the most, and hence, were most likely to engage in massed learning, it was expected that they would forget the most and that $\overline{D}_r$ would be largest. Following a similar argument and based on the results from analyzing the procrastination data, it was expected that the next largest mean difference would be $\overline{D}_a$, so that $\overline{D}_r > \overline{D}_a > \overline{D}_c$. As the distance between $\overline{D}_r$, $\overline{D}_a$, and $\overline{D}_c$ increases, so does the value of

$$s = (\overline{D}_r - \overline{D}_a) + (\overline{D}_r - \overline{D}_c) + (\overline{D}_a - \overline{D}_c).$$

After canceling a few terms, this yields $s = 2\overline{D}_r - 2\overline{D}_c$, or $s = 2(\overline{D}_r - \overline{D}_c)$. Interestingly, this omnibus test reduces to an examination of the magnitude of the distance between the two points in the difference dimension that were expected to be farthest from one another. This is reasonable considering the fact that the purpose of the omnibus test is to determine whether or not a large enough overall difference exists between groups to warrant pairwise comparisons. A randomization test based on s indicated that the value of s for the original data, $s_0 = 9.59$ was extreme enough ($p = .0199$) to suggest that the null hypothesis be rejected in favor of

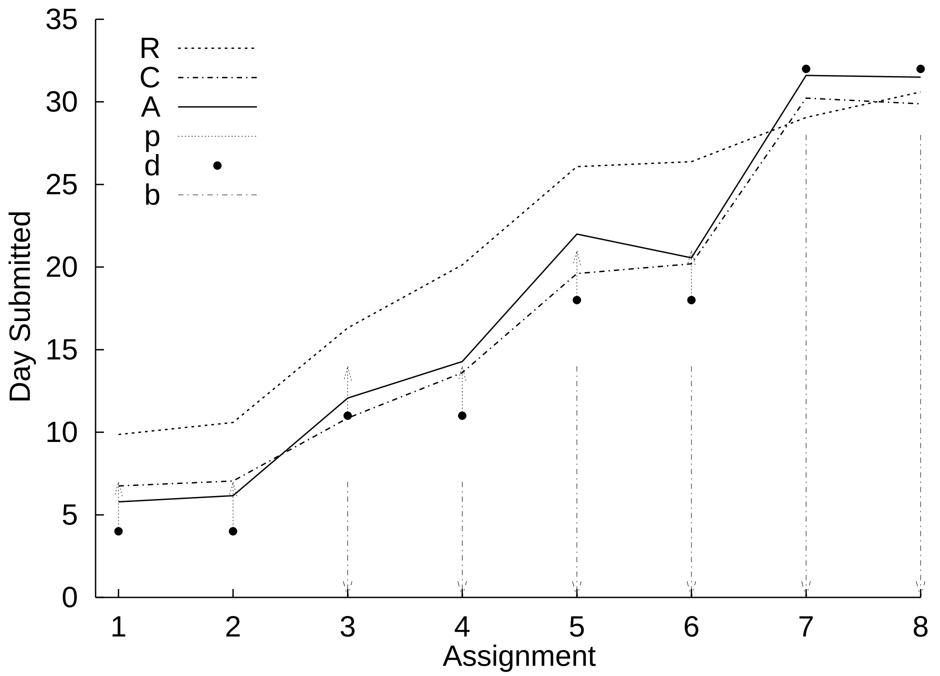

Figure 24. Procrastination level with no missing data. Missing assignments were not included when calculating average submission days. Hence, the averages for A, and to a lesser extent for R, do not reflect the fact that fewer students actually submitted each assignment. R, C, and A are the treatments, d is the common due date across treatments, and p and b are the penalty and bonus intervals for students in C.

the alternative that the treatment condition had some effect on how much students forgot between taking the posttest and the retention test. Although the omnibus test above focused on whether or not there was an overall difference between the difference scores in the direction indicated by the procrastination results, recall that procrastination levels did not differ significantly between groups R and A. Using an alternative omnibus test, where

$$s = |\overline{D}_r - \overline{D}_a| + (\overline{D}_r - \overline{D}_c) + (\overline{D}_a - \overline{D}_c),$$

s_0 still was 9.59 and extreme enough ($p = .0411$) to warrant further investigation of the difference scores.

In order to determine which difference scores differed significantly, three separate randomization tests were performed, one for each of the tests $\overline{D}_r - \overline{D}_a$, $\overline{D}_r - \overline{D}_c$, and $\overline{D}_a - \overline{D}_c$. A Bonferroni adjustment by a factor of three, converted the nominal alpha from .05 to .0167. Although none of the individual tests, strictly speaking, was statistically significant for this adjusted alpha, the test $\overline{D}_r - \overline{D}_c$ was the most significant with $s_0 = 4.79$, $p = .0190$. For test $\overline{D}_r - \overline{D}_a$, $s_0 = 3.18$, $p = .0891$, and for test $\overline{D}_a - \overline{D}_c$, $s_0 = 1.61$, $p = .2613$. The effect sizes for these latter mean differences were both fairly small, with $\hat{d} = 0.29$ for groups R and A and $\hat{d} = 0.14$ for groups A and C. With a roughly medium effect size of $\hat{d} = 0.43$ and a difference between average difference scores of approximately one-half of a letter grade, differences between groups R and C likely accounted for the significance of the omnibus test. In fact, if the test $\overline{D}_r - \overline{D}_a$ were discarded based on the fact that the procrastination levels for these two groups did not differ significantly, then the Bonferroni adjustment would change the nominal alpha to .025 instead of .0167, in which case the test $\overline{D}_r - \overline{D}_c$ would be statistically significant. Figure 27 gives further visual evidence of a possible interaction between time and treatment for groups R and C.

Now let $\overline{PT}_g$ and $\overline{RT}_g$ be the average posttest and retention test scores for students in group g, respectively, where $g \in \{r, c, a\}$. Considering the posttest scores alone, the two-sided, omnibus randomization test

$$(\overline{PT}_r - \overline{PT}_c)^2 + (\overline{PT}_r - \overline{PT}_a)^2 + (\overline{PT}_c - \overline{PT}_a)^2$$

indicated that, as expected, there was no significant difference between achievement scores with $s_0 = 114.15$, $p = .1995$. Also, the effect size for groups C and R was $\hat{d} = 0.05$. However, students in A earned substantially lower posttest scores, on average. In fact, the means for groups C and A differed by 8.09 points or nearly one letter grade, and the effect size was $\hat{d} = 0.36$. Also, the effect size $\hat{d} = 0.30$

for groups R and A was relatively high as was the 6.86 point difference between means.

Next, the retention test scores were considered alone using the one-sided omnibus test $2\overline{RT}_c - 2\overline{RT}_r$. The test was derived from

$$(\overline{RT}_c - \overline{RT}_a) + (\overline{RT}_c - \overline{RT}_r) + (\overline{RT}_a - \overline{RT}_r),$$

which was formulated based on the prediction that $\overline{RT}_c > \overline{RT}_a > \overline{RT}_r$, because $\overline{P}_r > \overline{P}_a > \overline{P}_c$. Statistically speaking, the treatment condition had no significant effect on the retention test scores, $s_0 = 12.06$, $p = .0845$. Effect sizes for the retention scores were smaller than expected, and in one case, the effect was actually in the opposite direction. Specifically, for groups C and R, where a large effect was expected, a small effect was found with $\hat{d} = 0.28$. For groups C and A, where less of an effect was expected, a medium effect was found with $\hat{d} = 0.48$ Even more surprising, for groups A and R, where a large effect was predicted initially, a small effect was found in the opposite direction with $\hat{d} = -0.17$. Recall, however, that procrastination levels also did not differ significantly between students in R and A as initially predicted, so a small insignificant effect in either direction may not be that strange.

There was some concern prior to conducting the study that students in C, who earned a large number of bonus points and high marks on all assignments, might be less motivated to perform well on the posttest. The 8 bonus points students in C were able to earn could only be applied toward the HTML portion of EdTech, which included a posttest worth 24 points. Thus, students in C could have already earned one-third of the points needed to get 100% on the posttest before even taking it. The only student, #256, who earned enough bonus points (4) as well as a high enough assignment score (111%) to raise concern actually earned 98% on the posttest. Therefore, bonus points did not seem to affect performance on the posttest and no action was taken. Considering both bonus and penalty points, it is interesting to note that, on average, students in R acquired -.56 points, students in C acquired -4.98 points, and students in A acquired -5.71 points. Although, bonus points earned throughout EdTech may have had a similar effect on the retention test, which was a subset of EdTech's Exam 2, the potential for earning these bonus points was evenly distributed across treatments. Therefore, they posed little or no threat to internal validity.

Table 11. Descriptive Univariate Statistics for Achievement Data

Treatment	*n*	*M*	*SD*	Skewness	Kurtosis	Min	Max
			Pretest				
R	48	27.17	15.03	0.36	-0.23	0.00	55.56
C	47	29.15	11.96	-0.19	-0.31	0.00	55.56
A	41	24.82	10.69	-0.28	-0.73	0.00	44.44
			Posttest				
R	48	45.99	23.94	0.45	-0.97	10.12	92.86
C	47	47.22	22.65	0.43	-0.40	11.16	98.81
A	41	39.13	22.16	0.58	-0.43	9.52	92.86
			Retention test				
R	48	34.36	22.42	0.85	-0.09	4.76	95.24
C	47	40.39	19.83	0.03	-1.02	4.76	76.19
A	41	30.68	21.02	0.60	-0.86	4.76	71.43
			Difference scores[a]				
R	48	11.63	10.41	0.58	0.16	-5.95	40.48
C	47	6.83	11.82	0.03	-0.53	-15.48	32.14
A	41	8.45	11.71	1.06	2.37	-14.29	47.62

[a] Posttest score minus retention test score.

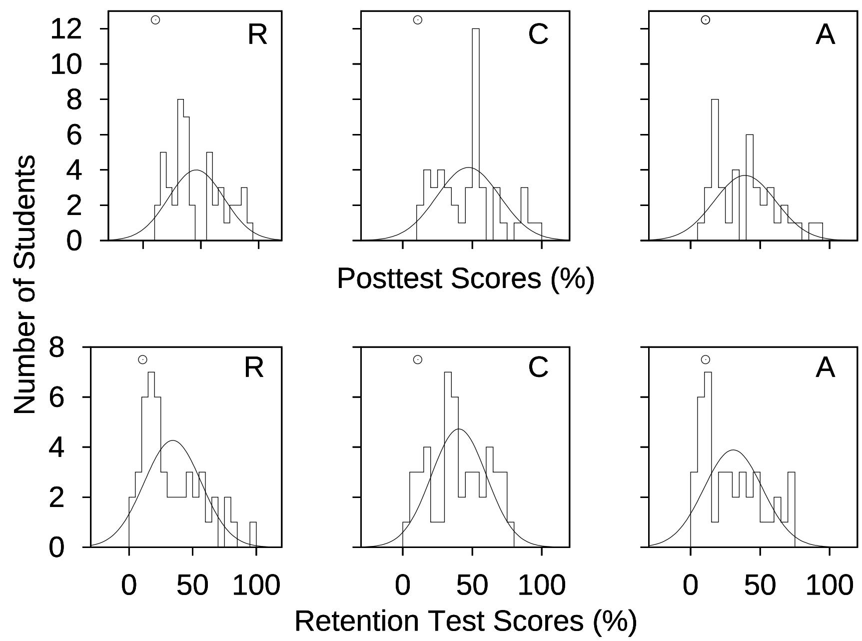

Figure 25. Achievement histograms. Totals are accumulated in increments of five points. For example, scores in the range [70,75) are accumulated in 70. The smooth normal curves provide visual references for determining departures from normality. The circles indicate the score a student would earn by chance.

4.5 Analysis of Free Format Responses

In an effort to acquire information on improving the courseware as well as a deeper understanding of study issues that might have affected outcomes, students, course assistants, and instructors were asked to provide free format feedback. Students were asked to answer the three free-response questions in Appendix P on the day the posttest was administered. When asked what they liked most about the HTML lessons and assignments, responses fell into the main categories listed in Table 12. Notice that students were most likely to state that they best liked either nothing, the relevant, interesting material and assignments, or the convenient content on demand. Although responses in a given category generally were distributed fairly well across treatments, it is interesting to note that twice as many students in R reported that they best liked the CoD. When asked what they liked least about the HTML lessons and assignments, the most common complaints were that the instruction was not adequate, that the material and assignments were too hard, and that an alternative teaching paradigm was preferred. Other paradigms mentioned included having live lectures, demonstrations, class discussions, group collaboration, and structured class time in a computer laboratory. See Table 13

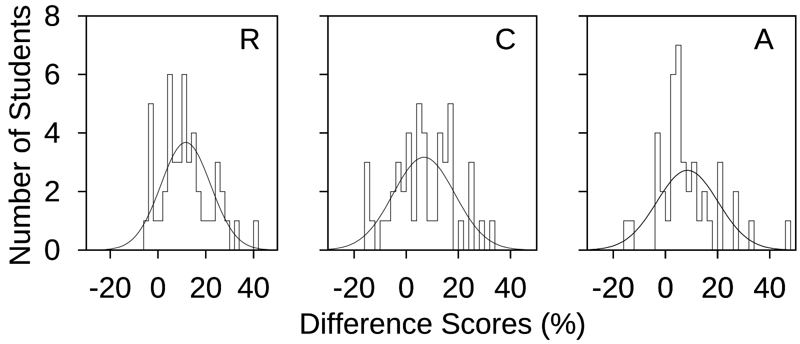

Figure 26. Histograms for achievement difference scores. Totals are accumulated in increments of two points. For example, scores in the range [20,22) are accumulated in 20. The smooth normal curves provide visual references for determining departures from normality.

for a complete listing of response categories. Notice that responses in each category again were distributed fairly well across treatments. In fact, according to two chi-square goodness of fit tests based on the number of positive responses and the number of negative responses made by students in each treatment condition, free format responses did not differ significantly across treatments. Specifically, $\chi^2 = 3.47$, $p = .1765$ for the positive responses, and $\chi^2 = 6.68$, $p = .0355$ for the negative responses. After making a Bonferroni adjustment by a factor of two, the nominal alpha changed from .05 to .025, and so, neither response type was statistically significant. Although students gave nearly four times as many negative responses as they did positive ones, the gains they made on their posttest scores over their pretest scores did indicate that they still were able to learn some of the material successfully. Of course, average posttest scores in the range (39,46) indicated that they also did not learn a substantial portion of the material, and hence, it is not surprising that many reported having more negative feelings about the experience.

Several factors may have contributed to the reduced effectiveness of the instruction, as evidenced by student comments. For example, some students reported that the assignments were difficult, time consuming, and not relevant. Others reported that the courseware and support from course personnel were not adequate. Still others reported feeling that they were not treated fairly. Providing students with more time to complete assignments and having course officials review all portions of the courseware and make suggestions about how to improve it prior to giving it to the students would likely reduce some of these problems substantially. When the students were asked directly what improvements they would make to the courseware and assignments, responses fell into the seven main categories below.

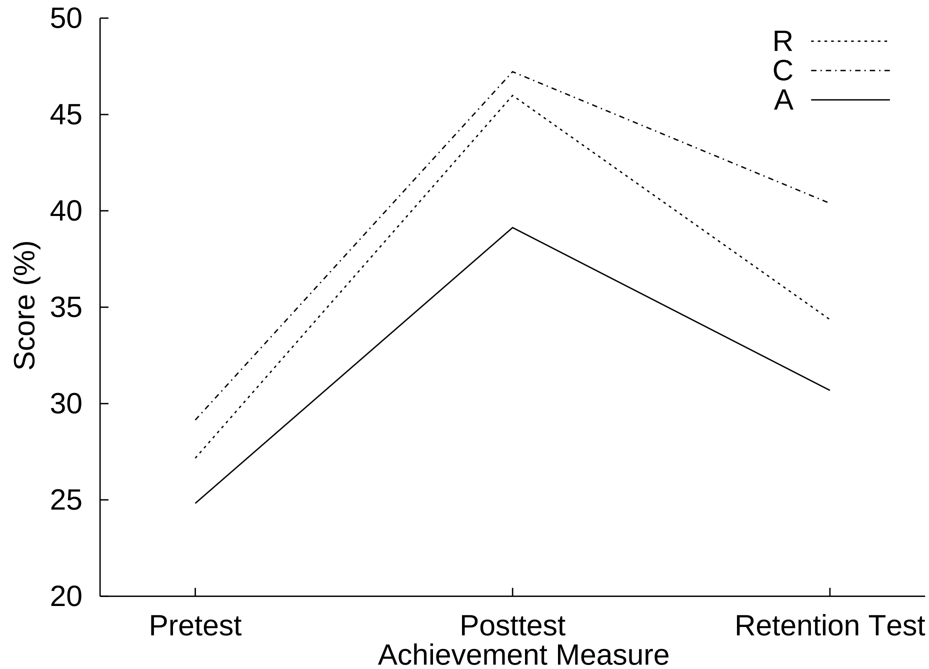

Figure 27. Time and treatment interaction for achievement data.

1. Either reduce the amount of work or give more time to complete it.
2. Provide more assistance.
3. Augment course material.
4. Alter the instructional paradigm somewhat.
5. Make sound accessible on more machines and easy to mute.
6. Provide option for printed material.
7. Make HTML unit extra credit rather than required.

For a listing of the exact responses counted in each category of suggested improvements as well as in each category of positive and negative responses, see Appendix Q. For category responses made by each individual, see Table 24.

Teaching assistants and facilitators were interviewed together in a casual setting on April 18. All teaching assistants except one and both course facilitators were present for the interview. They echoed the first suggestion above and stated that many students were angry and frustrated, because they needed more time to complete the assignments. This was especially true for lesson five, which the course officials indicated might have been too advanced for the students. However, the officials did report that some students loved the experience, that few students came to them for help, and that no students requested to review feedback on their

Table 12. What Students Reported Liking Best

Response Categories	Treatment R	C	A	Total
Nothing	11	17	20	48
Pride in own accomplishments	3	4	3	10
Relevant, interesting material and assignments	17	20	10	47
Content on demand	17	9	8	34
Convenient submission process	2	0	1	3
Exposure to different instructional paradigm	1	0	3	4
Tutorial relationship with assistant	2	0	0	2
Examples, layout of lessons, and small steps	2	4	3	9
Narration	1	2	1	4
Total positive[a] responses	45	39	29	113
Percentage positive responses	40	35	26	101

Note. For a given student and a given category, the category was counted only once, even if the student made more than one comment in that category.

[a] The response of "Nothing" is not included in these totals and percentages, which are based on 113 total category responses made by students.

posttest answers. Like the students, the officials suggested that future versions of the courseware should make it easy to mute the sound. Also, they felt that the posttest was too hard, that textual material should accompany the audio message, that the courseware should have been discussed more in class at the start of the study, and that the grading rubrics did not provide an adequate means of distinguishing between students who did excellent work from those who just met the minimum requirements. One official said that the online rubrics would be easier to use, if a "select all" option was added. Another stated that it would be nice to be able to look at a summary of assignment grades to see how a given student was progressing. When asked whether or not they noticed any difference between students in different treatments, the officials indicated that students in A complained a lot, students in R did not come for help until very late, and that students in A were not able to get the same level of help, because assignments were due on Fridays. None of the course officials had office hours on Fridays, and they felt that many of the students did not start the assignments until the preceding Thursdays. Unlike students in A, students in R and C could get help from the officials on the following Mondays and still submit their work for credit.

Table 13. What Students Reported Liking Least

Response Categories	Treatment R	C	A	Total
Time consuming	5	6	5	16
Courseware layout	2	5	3	10
Instruction not adequate	28	29	29	86
Assignment requirements not clear	0	4	2	6
Material and assignments too hard	11	18	18	47
Prefer alternative teaching paradigm	15	22	16	53
Narration	3	8	7	18
Technical difficulties	7	11	5	23
Submission procedure	0	2	1	3
No sound	4	3	0	7
Material not stimulating and relevant	4	5	8	17
Prefer WYSIWYG[a]	2	2	5	9
Interaction with teaching assistants and instructors	7	11	6	24
Deadlines	9	10	8	27
Unfair grading	6	7	5	18
Forced participation in study	1	4	2	7
Feeling of failure and defeat	8	3	5	16
Total negative[b] responses	123	167	145	435
Percentage of negative responses	28	38	33	99

Note. For a given student and a given category, the category was counted only once, even if the student made more than one comment in that category.

[a] Stands for "what you see is what you get" and refers to the interface provided by software products such as FrontPage. [b] The response of "Nothing" from Table 12 is included in these totals and percentages, which are based on 435 total category responses made by students.

Chapter 5

Discussion

The current educational system appears to be shifting toward a more learner-centered approach as evidenced by increased offerings of distant courses and programs, by more content being delivered online and on demand, by teachers acting as tutors, facilitators and coaches rather than simply as disseminators of information, by the growth of online learning communities supported by ALNs, and by increased interest in performance-based outcomes such as the attainment of competencies and the creation of portfolios. Technological advances such as CAI, CMI, and the Internet have made this paradigm shift possible by giving practitioners the ability to supply learners with rich media elements on demand and to track easily the progress of individual students. Some specific tools include off-the-shelf packages like WebCT and Blackboard as well as special-purpose systems like the one developed for the current study.

New educational approaches are now possible and some older ones are more feasible. For example, the learner-centered tenets of PSI, with their focus on self-paced progress, mastery of all material by all students, motivational instructor-student interactions, content on demand (CoD), and tutorial relationships with senior level students, make it a good candidate for reconsideration in light of current educational trends. Its success in raising the immediate acquisition and long term retention of content by students and their preference for it over traditional instruction have been well documented. It also promotes personal growth by shifting the responsibility of knowledge acquisition to the student.

Unfortunately, given the freedom to self-pace, many students procrastinate, which potentially leads to higher drop out rates, higher workloads for graders at the end of the term, and according to the current study, reduced long term retention of content. The self-paced component of PSI also makes it harder to grade students' work consistently, to track their performance, to provide them with solutions in a timely fashion, to catch cheating, and to fit the course into a fixed time frame. Furthermore, one might argue that self-pacing fosters an unrealistic world view. After all, is it really reasonable to expect that a future employer or client will wait indefinitely for a report? The employee or consultant who consistently misses deadlines is likely to find less opportunities and chances for advancement in the future. Automation can help alleviate some of the problems associated with procrastination. Programs can help instructors track students and keep grading consistent by logging all information in a database and by making rubrics easy to access and update. They can also aid in catching cheating by keeping a record of all student submissions and comparing new submissions for close matches with prior ones. Other problems associated with procrastination can be minimized by using deadlines and contingencies to encourage students to maintain steady progress. Under these conditions, complete self-pacing is reduced to having the ability to access CoD, which might be considered a lesser form of self-pacing. The present study investigated the effects this might have on student satisfaction, procrastination, and achievement.

5.1 Findings

Although the study took place in an authentic setting, every attempt was made to control for all factors other than the deadline contingencies applied to the three treatment conditions: recommended (R), conditional (C), and absolute (A) deadlines. Unlike earlier studies conducted on deadline contingencies under conditions of PSI, this study focused on the submission of assignments rather than the taking of quizzes. The mastery requirement was absent from all treatments, so that it was not confounded with self-pacing as in some past studies. Study findings were strengthened by randomly assigning all students in a large class to the treatment conditions, having each TA administer each treatment to roughly equal numbers of students, and by systematically informing all course officials and students about the nature of the study, the uncertainty of the findings, and the steps that would be taken to equalize any treatment effects that arose. Although the authentic environment did make it more difficult to identify and control for all possible extraneous variables, it also raised the ecological validity of the study. Results should generalize at least to undergraduate, preservice teachers in a college setting, and possibly to adult learners in general. Of course more research is needed with other subjects and groups of adult learners to justify such an extension of findings.

5.1.1 Procrastination Level

Before considering the procrastination results, a reexamination of the measure used to obtain them is appropriate. Recall that the rate of relative digression from the target response (RDTR) is actually a measure of when assignments are started and of their difficulty. One might argue that a better measure would be one that indicates when a student first begins an assignment. However, measuring this is problematic. One would either have to depend on less reliable self report data or on timestamps of when students first access assignment descriptions. In the latter case, students would have to be restricted from accessing all descriptions at once. Even if access to a given assignment description was not allowed until the previous one had been submitted, there is still no guarantee that the student accessing it will start working on it right away. Based on the studies reviewed, the rate of RDTR appears to be the most comprehensive, sensitive, and reliable measure of total work distribution patterns available when compared to other measures which only consider a subset of the assignments or treatment interval, discretize the treatment interval or response pattern, consider only positive or negative responses alone, or rely on the subjective inspection of graphs.

According to the formula for the rate of RDTR, students who submit fewer assignments will have a higher RDTR value. Because students in group A submitted fewer assignments, their rates likely were inflated. Unfortunately, students in A actually may have completed approximately the same number of assignments, but simply did not submit them. Recall that their contingency was to receive no credit for late work, so they may not have seen the value in submitting late work for feedback only. Therefore, differences in RDTR rates with respect to A need to be interpreted with care. According to randomization tests on RDTR rates, there was strong evidence that students in R procrastinated more than students in C. In fact, differences were arguably practical with students in R submitting assignments approximately four days later than students in C. There was also some evidence that students in A procrastinated more than students in C. Again, even though students in A submitted assignments more than three days later than students in C, these results must be interpreted with care. Likewise, the minimal difference between RDTR rates between students in groups R and A, with R submitting assignments nearly one full day earlier than students in A, are somewhat questionable. Although no conclusions about significance can be drawn, it is also interesting to note that students in C and A requested slightly more deadline extensions than students in R, and that TAs reported noticing students in R did not come for help until late in the treatment interval.

5.1.2 Pacing Preference

As expected, students in the three deadline contingencies did not appear to differ significantly in their attitudes toward self-pacing, as evidenced by ANOVA results. According to chi-square tests on free format responses, they also did not appear to differ significantly in their feelings about the courseware. Although students in A were the ones most likely to say that they liked nothing best about the courseware, and students in R were the ones most likely to say that they liked the availability of CoD, two separate chi-square tests indicated no significant difference between groups in the total number of positive responses and the total number of negative responses. These findings are in harmony with those of other researchers who have compared course evaluations from students exposed to different deadline contingencies.

5.1.3 Achievement Data

Before considering any results from the analysis of the achievement data, it is advisable to review some of the disproportionate problems encountered by students in A. First, although no statistically significant differences between groups were identified at the start of the study, the direction of many differences indicated a disadvantage for students in A. They reported less prior experience with document typesetting and programming on the pretest and had lower pretest scores. In fact, although the omnibus test of pretest differences was not statistically significant, the average four percentage point advantage for students in C over students in A had near statistical significance ($p = 0.0551$) and the effect size of $\hat{d} = 0.38$ would be considered practical by many researchers (Gall, Borg, & Gall, 1996). In addition, of the 20 students who were missing both the posttest and the retention test and who were dropped from analysis, those in A earned half a letter grade higher on Exam 1 in EdTech than those in R and C. If slightly better students were dropped from A, then it is reasonable to assume that A might, on average, have slightly lower outcomes on achievement measures. Like the pretest, differences in posttest scores were not statistically significant, but were arguably practical with an average eight point advantage for students in C ($\hat{d} = 0.36$) and a seven point advantage for students in R ($\hat{d} = 0.30$). In addition, four students in A experienced verifiable technical problems beyond their control, with one unable to submit some of the assignments due to a limitation in the online scripts for handling name punctuation, and with three others receiving corrupt courseware CD-ROMs. It is possible that more students in A received corrupt CD-ROMs and either did not realize it or did not report it.

Possibly of greater consequence were two problems associated with the nature of the deadline contingency experienced by students in A. First, because they were required to meet each deadline or lose all points for the given assignment, they likely were the first students to complete each assignment. The TAs, who were completing the assignments at the same time as the students, likely were less versed in the solutions as these lead students approached them with questions. In addition, all assignments were due on Fridays at midnight, and none of the TAs had office hours on Fridays. The TAs reported that, as a consequence, students in group A, who often appeared to delay starting the assignments until Thursdays, were less able to get help and complained more. Students in R and C could still get help on Mondays and turn in their work for full, or at least partial, credit. Following a similar argument, students in A were the ones most affected by the brief one day interval between the administration of Exam 1 and the first study deadline. Students in C also were affected, of course, but to a lesser extent than students in A. The other problem associated with the nature of the deadline contingencies is a consequence of applying all treatments simultaneously to students in the same class. With the hope that no one would feel demoralized, all parties were informed systematically of the differences between treatments and of how possible differences in outcomes would be handled equitably. However, it is still possible that students in A did feel they were at a disadvantage and were helpless to do anything about it. Perhaps many gave up as they continued to submit work and receive no points. The likelihood that the data garnered for students in A were affected adversely by the problems outlined above warrants using extreme caution in interpreting any results regarding students in A.

Results from analysis of the achievement data indicate that applying conditional deadlines produces the best results. First, there were fewer students in C who appeared to be non-starters. Presumably, non-starters, who submitted no assignments, either chose not to participate or started so late that they felt they could not succeed and decided not to proceed. There were 11 such individuals in R, 7 in A, and only 4 in C. After taking into account the predetermined study groups for these individuals, the 11 in R were reduced to 8 data points. Thus, twice as many students in R and A appeared to disengage. Even more problematic is the fact that some of the students in R and A were better students based on higher Exam 1 scores, which were, on average, approximately two letter grades higher than the Exam 1 scores of non-starters in C. Because there were more non-starters in R and A, it is likely that more students guessed at the answers on the posttest and retention test in these groups. This, coupled with the fact that some better students in these two groups were included in the subset of guessers, likely had the effect of lowering posttest and retention test scores for students in R and A. Although one might argue that retaining these data points in subsequent analyses likely inflated the differences in achievement scores between students in group C and those in the other two groups, it would seem important to acknowledge that all students in C, except for a few apparently low achievers, stayed engaged. In fact, it might be argued that dropping the non-starters from analysis would artificially inflate the scores of students in R and A. Thus, data for the non-starters were maintained. It is interesting to note that the greater number of non-starters in R likely accounted for the higher percentage of assignment submissions by students in C. However, the percentage of submissions by students in A was lower than could be accounted for by the presence of additional non-starters alone and is likely related to some of the problems discussed above. In short, contingency C appears superior in keeping more students engaged, including some higher achievers.

According to the randomization tests performed on the achievement data, the trend over time appears to favor students in C remembering more of what they learned. The statistical significance of the omnibus test on amounts forgotten[1], coupled with the near statistical significance of the difference between students in R and C, provide some evidence that students in R tended to forget more of what they learned over time than did students in C. The difference in the difference scores between groups R and C was highest, and hence, was the most likely candidate to explain the significance of the omnibus test. Furthermore, if the difference between R and A is removed from consideration due to the fact that the average RDTR rates did not show a significant difference in procrastination levels for students in these groups, then the difference between R and C is statistically significant. The evidence in favor of a difference between R and C would be strengthened even more if A were not included in the analysis, which one might argue is reasonable based on the differential problems students in A experienced. In addition, the difference between the amounts forgotten by students in R and C is arguably practical ($\hat{d} = 0.43$) with students in R forgetting one half of a letter grade more material in a month than did students in C. Also, if the trends depicted in the interaction graph in Figure 27 continue to change at roughly the same rates given more time, it is reasonable to expect that the evidence for C supporting better long term retention of content will grow stronger still.

Considering the small to medium sized effects ($\hat{d} \in$ [-0.17, 0.48]) of the treatments on retention test scores alone, they clearly were lower than the anticipated large effects. Also, the negative effect between R and A was contrary to expectations, but not surprising in light of the problems A experienced and the fact that evidence indicated students in these two groups did not differ significantly in their procrastination levels. As mentioned above, a longer retention interval would increase the effects detected, if trends continued at the same rate. Another factor which may have reduced effect sizes involved informing students that HTML questions would appear on Exam 2 two days before they took it. Consequently, they had ample opportunity to review the material and relearn it, or even to learn concepts they had not learned during the treatment interval. Although Kulik et al. (1979) stated that it was better not to announce retention exams, the retention questions for this study were incorporated into Exam 2 and played a part in determining the students' final grades in EdTech. Morally, it seemed more appropriate to inform the students than to withhold this information. Of the studies reviewed which considered the effects of pacing on retention test scores, the one that appeared to have the strongest design incorporated an unannounced retention test and reported a large effect. In the other four studies, researchers either stated explicitly that they had informed the students of the retention test in advance, or it appeared implicitly that they had. Unfortunately, these studies also suffered from a myriad of potentially serious design flaws and problems, prompting the need to interpret their findings with caution. Problems included the use of volunteers, small

[1] Recall that the amount forgotten by a given student was determined by calculating a difference score, where the retention test score was subtracted from the posttest score.

group sizes, differential dropping from treatment conditions, weak evidence of differences in pacing patterns, exposing some students to longer retention intervals, telling students their performance would not affect their grade in any way, a low mastery criterion of 50% for the retention test, and having retention scores for less than half of the students. In summary, effect sizes might be raised in future studies by lengthening the retention interval and by not announcing the retention test before it is given.

5.2 Future Research and Practices

Before any definitive conclusions can be drawn, more research is needed to replicate the findings of this study with respect to recommended and conditional deadlines, to clarify the effects of absolute deadline contingencies, and to enable generalizations to other content areas and groups of learners. For those interested in replicating this study using the same courseware and comparable students, suggestions are made for improving the methodology and the courseware as well as for providing the students and course officials with better support. Other related areas of research are also suggested, such as the development of useful tools and methods of helping instructors and learners make a smooth transition to their new roles.

5.2.1 Replicating Study

A few methodological enhancements should strengthen future replications of this work. First, because many of the study groupings formed by the students appeared to be somewhat fluid in nature, reduction of the initial power of the study could be avoided by not assigning students to treatments based on these groupings and then subsequently averaging members' scores into single data points. Students could be asked to report the names of fellow students with whom they collaborated on the HTML assignments. If many stable groupings emerged, then the data could be analyzed using randomization tests similar to those employed in the current study. Alternatively, one might plan to analyze the data via the randomization model from the start, eliminating the need to collect data on collaboration. It should be noted, however, that randomization tests do not yield exactly the same information as do tests based on ANOVA. The latter technique tests the null hypothesis that the treatment has no effect on mean scores, while the former tests the null hypothesis that the treatment has no effect on score distributions. Although similar, there is a subtle difference in focus which should be considered when choosing between these techniques.

In future replications, it also would be advisable to analyze the pretest data before distributing the CD-ROMs, so that students could be reassigned randomly to treatments, if the initial randomization produced unequal groups with respect to the pretest. If similar students participate in the replication, then the treatment interval should be increased from one month to two months. The retention interval also should be increased from one month to two months in order to increase effect size and power. Preferably, treatments R, C, and A would be included in order to replicate the findings reported here in favor of C and to clarify the findings with respect to A. In fact, future studies may reveal that A actually is better, if one wishes to encourage students to distribute their work uniformly over the entire treatment interval. Given a more reasonable time frame, some students in C may amass their work near the beginning of the interval, hoping to accrue as many bonus points as possible. This likely would be just as undesirable as amassing learning near the end of the interval. One might wish to adjust the deadlines slightly, so that the last day students can receive any credit for an assignment is the same, at least, for students in C and A. Then, students in A would not be pushed to complete assignments faster than students in C. Care should be taken in describing contingencies with positive rather than negative terms. For example, rather than discuss C in terms of bonuses and penalties, one might explain that work submitted on a given assignment prior to a certain date is worth 5 points, prior to another is worth 4 points, prior to another 3 points, and prior to the end of the course 0 points. Finally, students might feel less coerced, if they had the option of completing an alternative assignment, even if they still chose to participate in the study.

If possible, the retention test should be unannounced. Morally, this is reasonable, if scores do not contribute directly to the students' grades. At the same time, however, students need to be encouraged to do their best. One scenario might be to distribute it with the last class exam. This should ensure good attendance. Then students could be motivated to complete the retention test by being told that it is worth extra credit toward the last exam, and the better they do, the more extra credit they earn. Of course, there is still the danger that many might choose not to take it, causing results to be skewed and based effectively on volunteers. However, considering the number of students in the current study who completed the extra credit opportunities, it is likely that most students would take the retention test. In addition, one might consider giving the posttest on the same day as another class exam, perhaps the midterm, in order to increase attendance. In this case, the posttest likely will need to be shortened.

One might opt to use the retention test from this study with or without alteration. If it is altered, then it is highly recommended that the new version also include an essay question with novel material. Not only did the essay question provide more reliable data than the multiple choice questions, but it also tested a more valuable skill. Because the goal of the courseware was to help students develop a new computer skill similar in nature to programming, being able to apply this knowledge was arguably more valuable than being able to recognize syntax. One change with respect to the essay question is recommended. Based on a comment made by one student regarding the disproportionately low number of points assigned to the essay question, the relative value of this question should be raised or not reported at all. One option might be to inform the student that the entire retention test is worth ten points and has the power to improve their score on the last exam by one letter grade. This should provide enough information to motivate the student without the need to disclose the exact point distribution.

It is also recommended that student support be enhanced. First, the CD-ROMs should be discussed and the navigation of the courseware demonstrated in class on the day they are distributed. Students should be advised to examine their copies right away, so that any technical problems can be addressed at the next class meeting, including the exchange of any corrupt CD-ROMs and clarification of how to navigate through the content. In addition, students should be encouraged to take notes as they progress through the material and to contact course officials via e-mail and/or office hours as questions arise. An outline of the course content might help support such note taking. They also should be provided with a list of FAQs that they can search for help. Ideally, solution code should be made available for each assignment after its deadline has passed. Unfortunately, there is no clear way to do this without either giving the students in R an unfair advantage or waiting to post the entire solution at one time after the treatment interval. Finally, a listserv is recommended in order to process student questions as efficiently as possible. Ideally, the listserv would allow students to send a question to all course officials at once that is not copied to fellow students. One official could be designated per day as the one responsible for responding quickly to all incoming queries. The others could monitor exchanges and add comments or clarifications, if desired. Answers should be sent back to the student and the listserv, which would be readable only by the course officials and study investigator. To make the whole process more efficient, it is recommended that the investigator continuously monitor the exchanges and post FAQs online.

In support of the course officials, corrections in their understanding of the material, prompted by their responses to students on the listserv, should be discussed with them privately, so that they can improve their grasp on the material and pass this information on to the student themselves. During their training, the importance of timely feedback on submitted work and e-mailed questions should be emphasized. Alternative policies, such as having one person designated as the listserv monitor per day and grading all pending assignments on at least three predetermined days per week should be discussed with, agreed upon by, and distributed in writing to all parties. One also should discuss with the TAs their tutorial role and the qualities of a good tutor. For example, they can address the students' affective needs by bolstering self-confidence, promoting feelings of control, and reducing feelings of isolation. They can address motivational needs by helping maintain challenge, evoking curiosity, and emphasizing the relevance of the content. Also, they can address cognitive needs by understanding the material well and reviewing assignments in advance.

In order to foster a deep understanding of the material and to teach the course officials how to navigate the courseware, they should be asked to review all material and to complete all assignments. This could be done in the context of making them a part of the design team and asking them to note recommendations for improving the courseware as they review it. Their review could be conducted during the first week of the semester and a meeting scheduled at the end of the week to discuss recommendations as well as the appropriateness and relevance of the material for their students. After such a thorough investigation of the courseware, they should be able to comment on the difficulty of the achievement tests and offer suggestions for improving them. However, this should be done with caution, if it all, as students are likely to ask officials what to expect. If the officials have not seen the exams, then there is less of a chance that students will receive differential information about them. In fact, it likely is best not to inform the TAs about the existence of the retention test. Finally, as in the current study, the TAs should be trained how to use the grading rubrics. If desired, an "overall quality" category might be added to each rubric, so that TAs can distinguish readily between students who just meet the minimum requirements and those who do more.

5.2.2 Improving Courseware

Several recommendations were made by students and course officials for improving the courseware and assignments. Some students indicated a desire for less rigid assignments with the freedom to be more creative. Others suggested that the requirement of presenting research on ergonomics be eliminated. Both of these requests might be addressed by allowing students to choose the topic they research, rather than forcing them to research ergonomics. If the course facilitator wants to direct their focus, as was the case in the current study, then a list of appropriate alternative topics could be supplied. In addition, lessons should be enhanced by discussing the relevance of learning HTML and how it relates to other important tools such as Flash, Authorware, JavaScript, Java, etc. Difficult lessons, in particular the fifth one, should be augmented with additional examples. Also, new modules on trouble shooting and helpful practices like using HTML validators, adding start and end tags together, adding one new line at a time, and commenting out sections of code should be incorporated.

Other improvements include providing a glossary, help section, and static FAQ section, with supplemental FAQs from the current course offering posted online. Several participants also recommended that the sound be accessible on more machines, that it be mutable, and that written transcripts be provided online or in print. The ability to bookmark pages and to highlight material online would greatly enhance the students' experience, but such alterations would require extensive revisions to the courseware programming. A less formidable improvement would be to make it easy for students to view assignment descriptions and course content simultaneously. This can already be accomplished by starting the courseware twice in two separate browsers. However, such an approach is not intuitive for introductory students like the ones in the current study. Students should either be informed explicitly of this process, or similar functionality should be built into the courseware. A simpler approach might be to provide students with printed material describing the assignments. Students requested that other material be provided in print form, including the reference material by the Web Design Group, the syllabus, and a booklet containing all courseware material. Also, it might be advisable to provide students with a list of supplemental books, and possibly with a list of pages to read for each courseware lesson, for those who prefer to learn from a book. Of course, this might introduce extraneous variables, but such problems are inherent when conducting studies in authentic environments. Finally, two improvements that would help TAs include adding a "select all" button to the grading rubrics and providing them with continuous tracking information on the progress of their students.

In making modifications to the courseware, care should be taken to maintain its good qualities. For example, lessons should be kept short, preferably under 10 minutes each. They should contain visual and auditory stimulus and actively engage students. Assignments should be suggested throughout the courseware, which promote immediate, distributed practice. Lessons should be relevant, interesting, and based on task analyses of target behaviors. All material should be supplied on demand. Finally, the courseware should permit and encourage collaboration with fellow students and support tutorial relationships with course officials by providing direct links to TAs' Web sites and e-mail forms for easily posting questions to the listserv and/or specific course officials.

5.2.3 Researching Related Issues

Rather than replicate the findings of this study, one might choose to develop tools that would support the current paradigm shift toward a learner-centered approach, which provides students with access to more and more CoD daily. For example, one might focus on developing a program that would allow students to highlight written material they read online, facilitate note taking with embedded links to content, and help them organize the material into summaries of key elements for future review. Methods might be designed which would allow users to select learning parameters such as preferred mode of learning. Then, based on their selection, they could be presented with appropriate content versions. Or, one might design an autonomous agent that could observe a learner's choices as well as evaluate the learner's level of understanding given those choices, so that it might suggest content in particular formats in the future. Tools might be developed to handle systematically submissions of assignments by groups of students working together with feedback sent back to all members as well as tools that facilitate grading group projects and portfolios. Also beneficial, would be the development of software tools that could analyze short answers and essays for key elements, even when concepts have been misspelled or replaced by synonyms. Perhaps one could write a program that would cross check entries in a thesaurus for likely matches between answers and target concepts. One might use HTML validators and program compilers in a similar fashion to aid in checking code. Another useful tool might help catch academic dishonesty by automatically checking submissions for close matches with past ones and alerting course officials when they are found. Tools that could verify the authenticity of responses made by distant learners taking exams would be invaluable. Finally, with the growing use of CAI, there is a need to develop methods that will allow such programs to address the affective side of the learner, perhaps by using a camera to analyze facial expressions for emotional state.

Other issues one might investigate include effective means of managing the growing number of course assistants, training assistants to be effective tutors, and helping students learn to take responsibility for knowledge acquisition and time management. In addition, one might focus on methods of managing and/or supporting collaboration between learners and of reducing feelings of isolation for distant learners. One might attempt to discern the most effective combinations of CoD, lectures, demonstrations, discussions, group work, and structured lab time for various content domains. And, of course, efficient procedures are needed for initial course development, conversion of classroom presentations to CoD, the sharing and maintenance of content modules, providing compensation for intellectual property, and handling technical problems that might arise as well as disparities in student access to technology.

To extend the findings of the current study and to verify that regulating pacing so that it is more uniform really does contribute to higher content retention, more research is needed. Studies should be conducted with on site and distant learners as well as with different age groups and content domains. Investigators might also consider massed versus spaced practice in traditional courses which do not provide CoD in an attempt to replicate the findings of other researchers (Grote, 1992, 1995; Bloom & Shuell, 1981). Although PSI has been shown to have distinct advantages over TI, it does not necessarily follow that CoD is a key component contributing to its success. Researchers might focus on comparing outcomes when content is delivered on demand versus via lecture. Because mastery, another element of PSI, has been shown to be a very effective teaching method, one might pursue methods of supporting mastery when pacing is regulated. Often during a course, unforeseen events or oversights make it necessary to adjust deadlines. It would be interesting to study the impact adjustments might have on the effectiveness of various contingencies in regulating pacing. Also, there is the issue of how to supply students with an assignment solution in a timely manner when not all students have turned in the assignment. Of course, one might choose to share the solution and then have these faster students help their classmates. For this to be effective, systematic means of rewarding and training these students in the art of tutoring would need to be in place.

Finally, other types of contingencies might be considered. For example, one might modify conditional deadlines, so that they follow a sliding scale, awarding increasing bonus points the earlier an assignment is submitted and increasing the penalty the later an assignment is submitted. Alternatively, one might investigate the use of student contracted deadlines that are less likely to push a student too fast and should promote personal growth in the form of self-discipline and a better understanding of one's own capabilities. Although past researchers found student contracted deadlines to be more time consuming, advances in technology may make it feasible to automate the process. Rather than allowing students to set their own deadlines, one might allow them to select the contingencies for meeting them from a range of possibilities like dropping a low grade, skipping an assignment, or earning bonus points (Murdock, 2000).

5.2.4 Incorporating Lessons Learned

In designing future studies, courses, and instructional material, one should attempt to incorporate important principles identified by past researchers. Instructional material should be of high quality with a common look and should incorporate diverse media with careful coordination between different elements. It should be continually and systematically maintained and updated, easily adaptable to specific learners and environments, based on objectives and task analyses, divided into short presentations, understandable and easily navigated by most students, and available on demand. Although it can be time consuming and expensive to develop, using off-the-shelf software when feasible and collaboration between developers can reduce associated costs. Of course, the equipment used to deliver the instructional material should be maintained at a high level, and every effort should be made to ensure that all students have equal access to it. One should consider supplying content to students in CD-ROM format when it requires a large bandwidth to deliver it online.

Good instructional practices include keeping students actively engaged, matching activities with objectives, constantly monitoring student performance, providing students with immediate and regular feedback, scheduling extra time to work out logistics when technology is involved, evaluating student performance as well as achievement, and providing structure with a clear, predictable schedule. It has also been suggested that online discussions be preceded by a formal introduction and followed by a closing summary. Finally, deadlines should be used when content is available on demand to reduce procrastination, and possibly raise long term retention of content.

In supporting students, one should utilize such learner-centered approaches as supplying CoD, collaboration, individualized instruction, and active participation in discussions. The delivery method should match the knowledge level of the students, and ideally, the format should support different learning styles. The use of automation should be balanced with personal attention, especially when distant learners are involved, in order to reduce feelings of isolation as well as the number of students who drop out or request incomplete grades. Toward this end staff should be available to assist students in a timely fashion, and it is recommended that the instructor attempt to respond to e-mailed questions at least once per day. Students also report that being able to review the work of fellow students is beneficial and that they are motivated to work harder when they know their peers might see their own work. It is also advisable to supply students with good examples of completed assignments. Fostering public and private communications with instructors and peers has also been recommended. Although one student may dominate the group and it can be difficult to assign credit to individuals, collaboration allows content to be viewed from many perspectives and can mitigate trepidation and be motivational when students see that others also are struggling with the material. Furthermore, students report a preference for discussions, which are superior in promoting problem solving, over lectures. While one student receives a needed explanation, the other gains a deeper understanding of the material through verbalization and by synthesizing ideas. Finally, students should be offered guidance in donning new roles where they are more responsible for the direction and pace of their own progress.

Like students, teachers also need training for new roles as instructional designers, tutors, facilitators, and managers/mentors of a growing number of assistants. As tutors, they should address the affective, motivational, and cognitive needs of their students, while taking care not to foster an unhealthy dependence on their feedback. They should train their assistants to be effective tutors as well. Lectures, when given, should be short. Although they do allow teachers to present a large amount of material efficiently, some of which may be unpublished, which is organized to best meets students' needs, student attention wanes quickly. Other advantages of short lectures include allowing the instructor to act as a scholarly role model and to impart enthusiastically the intrinsic value of the material in a way that puts little pressure on the students and is well suited for auditory learners. Of course, some of these advantages would likely translate to CoD, which incorporates video, or simply narration.

When developing new material, instructors should enjoy reduced teaching loads, because it is time consuming to produce, especially when video is involved. They also should be compensated by, at least, having their efforts noted systematically in applications for promotion and tenure. Coordinating design and production efforts with fellow instructors as well as continued staff development should help reduce feelings of dissatisfaction, frustration, insecurity, and powerlessness experienced by some teachers as they find themselves thrust into new roles. Teamwork should increase feelings of satisfaction and distribute the workload as well as provide students with access to different perspectives and presentation styles. If two instructors produce modules on the same topic, then students would have the option of reviewing both, if they felt it necessary. Finally, as the student-teacher ratio grows, the teacher must be supported with additional assistants and strong administrative support.

Advances in technology make it feasible to deliver quality CoD. This allows students to skip material they already know and to review material more than once, if necessary. As mentioned, they also can examine material created by different content providers and select presentations that best support their own learning preferences and needs. Delivering content via the Internet makes it easier for content providers to add new modules, update old ones, and to collaborate with other providers, possibly adding links to their work. Tools which support computer managed instruction provide convenient ways for students to submit their work and for graders to access it. They also make it easier to track students. In addition, grading tools can reduce workload by automatically grading objective tests and sending feedback. Of course, there is no way to guarantee that students taking quizzes online are not consulting other sources. At this point, online quizzes should be used diagnostically to indicate the current level of understanding and possible need for remediation, with little or no effect on students' grades. It is recommended that distant and local students be required to complete at least one on-site test or interview to verify their identity and depth of understanding.

5.3 Conclusions

Current learner-centered trends such as the increasing availability of content on demand (CoD) and support of distant learners, have some experts predicting that there will be fewer colleges, more competition between schools, more adjuncts, and better support for students of all ages in the future. As learners take greater responsibility for the direction and pace of their education, they need guidance in setting personal deadlines and selecting material and presentation modes. They also need to be given prompt and continuous feedback on performance as well as achievement level. Public and private communications with fellow students and teachers should be facilitated. Quality examples of expected outcomes as well as the work of other students should be provided. Instructors should balance short presentations with opportunities for students to participate actively. Like students, instructors need training, support, and recognition in their new roles as instructional designers, tutors, facilitators, and managers/mentors of the growing ranks of assistants. Although the Internet can provide a convenient mechanism for supporting communication, the submission of assignments, and the delivery of quality CoD, care should be taken to ensure that all learners have equal access. Material that requires a large bandwidth such as video presentations and narrations might best be delivered via CD-ROM at this point.

Advances in technology make some types of learner-centered instruction more feasible. In particular, Keller's Personalized System of Instruction warrants renewed consideration with its ability to improve immediate learning, increase long term content retention, and garner more favorable evaluations from students. Although its self-paced component allows students to balance school work with other demands, causes less frustration by not forcing them to proceed too quickly or too slowly, and encourages them to be more independent and self-reliant, it also leads to higher levels of procrastination. Another component of PSI, CoD, really might be considered a lesser form of self-pacing and may provide many of the same advantages, while allowing the pace at which students submit their work to be regulated via deadline contingencies. In general, contingencies have been shown to reduce procrastination without detriment to immediate achievement and satisfaction. Based on investigations of massed versus distributed practice, contingencies also may enhance memory function.

The current study brought together these two lines of research, the use of deadline contingencies and the benefits of distributed practice, in an attempt to extend the findings in favor of contingencies and to offer an explanation for their possible long term advantage in content retention. Because of numerous problems experienced by students randomly assigned to the absolute deadline (A) contingency, findings were questionable for this group and the following discussion focuses on differences between students with recommended (R) versus conditional deadlines (C). According to a comprehensive, sensitive, and reliable measure of procrastination developed for the current study, relative digression from the target response (RDTR), students in R submitted assignments significantly later than students in C with a practical difference of four days. There was no significant difference between groups in pacing preference or course satisfaction. There were fewer non-starters in C than in R, and those in C all appeared to be the lowest achievers. Also, a significant omnibus test, with the largest difference between groups R and C, provided evidence that students in R were likely to forget more one month after learning about HTML. In fact, students in R earned half a letter grade lower on the retention test, and the analysis of difference scores revealed a roughly medium effect ($\hat{d} = 0.43$) in favor of students in C. Given more time and an unannounced retention test, differences likely would have been even greater. Although, as mentioned, findings with respect to A are inconclusive, the current study suggests the superiority of conditional deadlines, which are simple to implement automatically with online scripts. In addition to enhancing memory function without detriment to immediate achievement and student satisfaction, reasonable deadlines along with conditional contingencies also facilitate consistent grading, better distribute the workload for course officials, and provide students with a more realistic experience.

Still, more research is needed to verify findings with respect to R and C, to clarify findings with respect to A, and to extend findings to other subject areas and groups of students, including distant and local learners as well as different age groups. At best, current findings generalize to undergraduate, preservice teachers in a college setting, and possibly support predictions about adult learners in general. Furthermore, although the authentic setting contributed to the ecological validity of the study, it also made it difficult to ensure that all possible extraneous variables were identified and controlled. Those who wish to replicate the current study should be aware that they may need to analyze the data using randomization tests and/or to reassign students to treatments based on pretest outcomes. They also should consider extending the training and retention intervals to two months each, including contingencies R, C, and A, setting deadlines so that the days on which C and A award no credit for late work coincide, describing contingencies as positively as possible, and allowing students to opt out of the study. With respect to the retention test, they should consider distributing it with the last exam, including an essay question with novel material, not announcing it, making it extra credit, and telling students that it can raise their final exam score by one letter grade, depending on how well they do. Also, they might consider reducing the length of the posttest and incorporating into the class midterm.

Those planning to replicate this study also should plan to enhance student and teacher support and make some improvements to the courseware. Officials should demonstrate navigation of the courseware the day CD-ROMs are distributed, encourage students to immediately inspect their copies and bring their questions as well as any corrupt CD-ROMs to the next class for exchange, encourage note taking by providing a sparse outline, and monitor personal e-mail and a listserv. The investigator should discuss with the instructors and assistants the practices of expert tutors who address the affective, motivational, and cognitive needs of their students, the importance of timely responses to e-mail and feedback on assignment submissions, how to use the grading rubrics, and policies regarding who will monitor the listserv each day and when assignments will be graded. The investigator also should have all course officials review all lessons, complete all assignments, and enlist their aid in improving the courseware by having them take notes on suggested improvements. In addition, the investigator should monitor communication on the listserv, privately clarify course officials' understanding of particular topics if necessary, and post FAQs online in such a way that ensures the integrity of the study. Finally, investigators will want to enhance the courseware by improving the fifth lesson, providing arguments for the relevance of learning HTML in light of the existence of programs like FrontPage and Flash, making the narrations more accessible and mutable, making it easier to view lessons and assignment descriptions simultaneously, allowing students more freedom in choosing a topic to research, and by including a glossary, transcripts, printed material, additional material on troubleshooting, and possibly a list of recommended books and readings. Also, assistants would appreciate the ability to select all rubrics at once and to monitor student performance.

Researchers who wish to investigate related issues might consider designing tools that support a more learner-centered approach, ways of helping instructors adapt to their new roles, having faster students help slower ones, and procedures for supporting collaborative instructional design efforts as well as for maintaining quality modules. One also might compare the merits of disseminating information via lecture versus supplying CoD, how to incorporate mastery when pacing is regulated, and the effects of deadline adjustments made necessary by unforeseen circumstances. In addition, researchers might investigate conditional contingencies where points are awarded on a sliding scale, depending on how early or late assignments are submitted as well as student contracted deadlines, including how contracting might be automated. Of course, one will want to consider the amount of work involved in administering any contingency considered. Finally, one might allow students to select a personal contingency plan from a list of alternatives.

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Appendices

Appendix A
Pilot Study Conducted During Fall 1999

A pilot study was conducted during Fall 1999 with 18 volunteers from EdTech. Initially, 30 students expressed interest in joining the study that was scheduled to take place during 6 one-hour sessions conducted on consecutive Fridays in a teaching laboratory equipped with 30 computers. Students signed up for one-hour time slots between 9 a.m. and 5 p.m. Then they were randomly assigned to one of two groups, recommended deadlines (R) versus absolute deadlines (A). The 2 one-hour time slots that accommodated the most students were between 11 a.m. and 12 p.m. and between 12 p.m. and 1 p.m. This reduced the number of eligible participants to 22.

Students were required to attend all 6 one-hour sessions of the pilot study in order to receive the 20 extra credit points offered as compensation. On the first day, 12 students were scheduled to attend the first session and 10 were scheduled to attend the second. One student (#13)[1] scheduled to attend the first session requested to change to the latter session due to a time conflict. All of the other 11 students signed up for the first session showed up the first day. Of these 11, 9 attended all 6 one-hour sessions. Only 5 of the 10 students signed up for the second session showed up the first day. However, one extra student (#23) showed up requesting to enter the study even though she had not signed up for it. Students #13 and #23 brought the total number in the second session to 7 on the first day. Of these 7, 6 attended all one-hour sessions. It should be noted that, on occasion, students who were not able to attend one of the sessions were allowed to make up the missed time by attending both one-hour sessions the following Friday.

All students received a copy of the information in Appendix B. Those sections received only by students in a given treatment are noted. The courseware and assignments used in the study replaced an assignment in the regular course worth 20 points. In order to entice volunteers to join the study, they were offered 20 extra credit points as compensation for their time. Any assignments they completed during the pilot study counted as additional points toward the class. Also, the score they earned on the posttest gained them additional points.

In essence, students only had to attend the 6 one-hour sessions to earn the 20 points for the regular class assignment. Any work they did during the pilot study counted as bonus points toward the class. Some students took advantage of this opportunity and completed many of the assignments. Most appeared to be actively accessing the courseware during the sessions. However, at least one student (#8) was observed reading e-mail during one of the sessions. Presumably then, some

[1] A master list of students indicates which number corresponds to each student. In order to ensure the anonymity of the students, they are only referred to by number herein.

of the students just attended the sessions to collect their 20 points and did not seriously pursue the course material. In fact, of the 15 students who attended all one-hour sessions, 5 turned in no assignments. Of those 5, observations made during the sessions revealed that at least 2 of them (#23 and #16) did actively engage in the courseware.

Because the students received 20 extra credit points simply for attending the sessions, the validity of any conclusions drawn about the effects of different deadline contingencies is somewhat questionable. However, a careful record was kept of when students submitted each assignment, and it is interesting to note that, in keeping with the findings of other researchers, students in R tended to procrastinate more than students in A. Figure 28 graphically depicts this by showing the average day each assignment was submitted by students in each treatment. Submissions were accepted on four Fridays during the study. Any received on the first Friday were recorded as having been submitted on day one. Those received on the second Friday were recorded as having been submitted on day two, etc. Those that were never received, were recorded as having been submitted on day five. For all assignments, except the last one, students in R submitted their work later than students in A. Consequently, students in R were not able to turn in as many assignments and earned lower assignment scores. In fact, Table 14 lists an average assignment score of 4 for students in R as compared to an average score of 8 for students in A. Also in agreement with the findings of other researchers, Table 14 shows that students in both treatments performed similarly on several measures of achievement.

Even though the effects of recommended versus absolute deadlines were difficult to determine due to the small sample size and the the large number of extra credit points awarded for attendance, valuable information was obtained regarding the adequacy of the courseware, the appropriateness of the assignments, the reliability of the achievement measures, and the need to track student requests for deadline extensions. These issues, along with changes made to the courseware are discussed in Appendix C. To review the raw data from the pilot study, please see Table 15.

Appendix A (Continued)

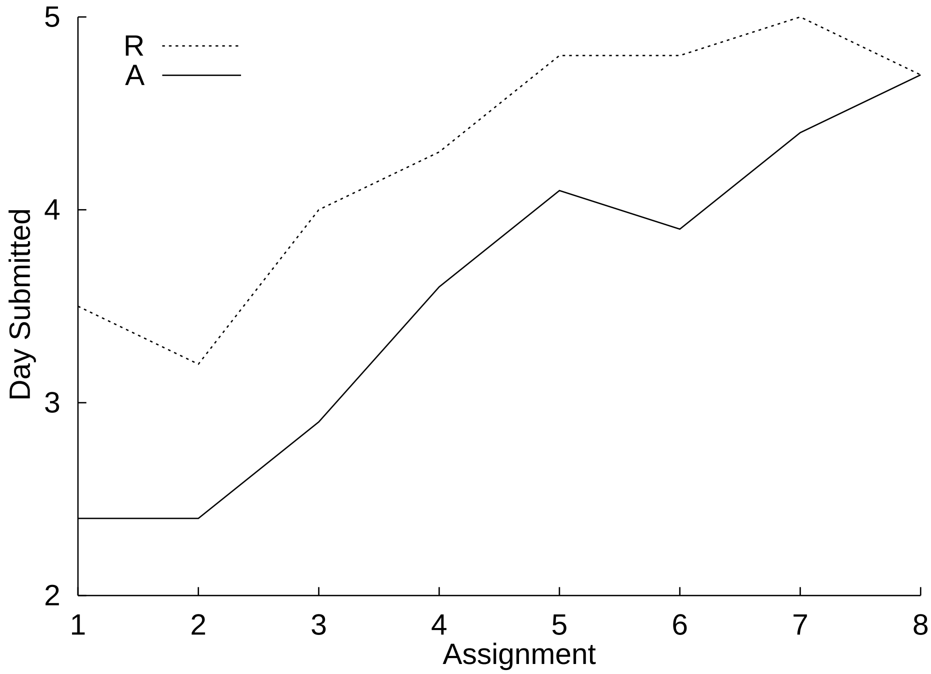

Figure 28. Procrastination levels during pilot study.

Table 14. Summary of Pilot Study Performance and Achievement Data

Treatment	Assignment Grade	Posttest questions 37[a]	26[b]	18[c]	E1[d]	E2[e]
Recommended						
M	4	18	13	9	4	5
SD	5	3	3	2	2	2
n	6	6	6	6	6	6
Absolute						
M	8	18	12	9	5	4
SD	7	4	5	3	3	2
n[f]	9	8	8	8	7	7

Note. Pilot and actual study essay questions were identical with the exception of objectives 4b and 5c.

[a]All pilot multiple choice questions. [b]Pilot multiple choice questions that appear on actual posttest in *some* form. [c]Pilot multiple choice questions that appear on actual posttest in *exact* form. [d]Essay questions rated on 1-11-2000. [e]Essay questions rated on 1-12-2000. [f]Multiple choice responses were missing for one student, and essays were missing for two.

Appendix A (Continued)

Table 15. Raw Data from Pilot Study

		Assignment[c]									Posttest				
ID[a]	I[b]	1	2	3	4	5	6	7	8	G	*37*[d]	26[e]	18[f]	E*1*[g]	E2[h]
					Recommended deadlines										
4	x	3	3	-	-	-	-	-	-	3	23	17	11	5	6
6		1	1	1	2	4	4	-	3	13	18	13	9	6	6
7	x	3	3	3	4	-	-	-	-	7	20	15	11	6	6
13		4	2	-	-	-	-	-	-	3	14	10	7	2	2
8		-	-	-	-	-	-	-	-	0	14	11	6	3	3
23	x	-	-	-	-	-	-	-	-	0	18	13	10	4	4
					Absolute deadlines										
11	x	1	1	-	2	-	3	-	-	7	18	13	9	8	7
12		1	1	1	-	3	-	-	-	7	25	20	13	3	3
14		1	1	1	2	4	2	3	4	15	19	14	10	8	8
15		1	1	1	4	4	4	4	-	13	12	7	5	3	4
20	x	2	2	2	2	2	3	4	-	13	23	17	12	5	5
18	x	1	1	1	2	4	3	4	3	15	16	3	7	-	-
16		-	-	-	-	-	-	-	-	0	-	-	-	3	2
17		-	-	-	-	-	-	-	-	0	16	12	7	-	-
19		-	-	-	-	-	-	-	-	0	14	9	7	2	2
Maximum possible points										15[i]	37	26	18	9	9
Average points earned by all students										6	18	12	9	5	5

Note. Dashes in assignment columns indicate those that were never submitted. Dashes in posttest columns indicate missing data.

[a]Identification number assigned to student to maintain anonymity. [b]Students interviewed on the last day. [c]Friday assignment was submitted at mastery level. [d]All pilot multiple choice questions. [e]Pilot multiple choice questions that appear on actual posttest in *some* form. [f]Pilot multiple choice questions that appear on actual posttest in *exact* form. [g]Essay questions rated on 1-11-2000. [h]Essay questions rated on 1-12-2000. [i]Does not include JavaScript assignment, which no one completed.

Appendix B
Instructions Given to Pilot Study Participants

Extra Credit

You receive 20 extra credit points toward your grade in EdTech for participating in this study. In order to participate fully and receive *any* of the 20 points, you must attend all 6 one-hour sessions.

Semester Project EFG

The assignments in this study replace the Semester Project EFG, which is worth 20 points. By completing the assignments in this study, you can earn up to 20 points (plus 5 extra points for taking the posttest on 10/29/1999) toward Project EFG. That means you can earn a total of 45 points by completing the study, all of the assignments, and earning 100% on a posttest covering the courseware material. This is in contrast to the maximum 20 points you could earn for Project EFG if you did not participate in the study.

Please note that, in order to receive the 5 points for completing the JavaScript assignment, you must have *successfully* completed *all* other assignments in the courseware. To complete an assignment successfully means that you earned full credit for it. That, in turn, means that you completed it by the deadline and that you lost no points.

After looking through the courseware package for the study and considering the assignments you will be asked to complete, you should decide if you would like to continue in the study. Alternatively, you can terminate your participation and complete Project EFG instead. You are free to terminate participation in the study at any time. Just keep in mind that you will need to leave yourself enough time to do Project EFG instead.

During One-hour Sessions

You will progress through the material in a self-paced manner, listening to the narrations for each page using headphones. If at any point, you have a question, you can pause the narration and let the teaching assistant know. She will have her own set of headphones that she can plug into your computer as well. You can replay the part you have a question about, listen to the narration together, and then pose your question.

You may ask the teaching assistant for help when completing assignments. You may also work together with fellow students. Time permitting, the teaching assistant can precheck your work before it is due and let you know if you would earn full credit for the assignment. If so, you can turn in the assignment early and have it checked off at that point.

Submitting Assignments and Bringing a Floppy Disk

You will submit your assignments during class. Time permitting, the teacher will check them with you, let you know how you did right away, and record your grade. Again, time permitting, you are welcome to get feedback on your assignments before you submit them for grading. The courseware recommends that you bring a floppy disk to class to save your work for yourself. You really should bring 2 disks (at least one is required), so that you can give one to your teacher in the case that time does not permit her to check your work off during class. It is your responsibility to provide her with this disk in that event.

Online Version of Courseware

If you would like to look through it outside of class, the courseware (minus narration) will be available online at *http://www.math.usf.edu/ tmajchrz/courseware/*.

Recommended Due Dates and Points
(given to participants in treatment R only)

If you hope to complete all assignments by the end of the course, it is recommended that you follow an assignment completion schedule. See Table 16 for a summary of the *recommended* due dates and total points for each assignment. These deadlines are merely recommended. You may submit all assignments on the last day if you wish. However, you are well advised not to wait until the end to do them all. In addition, waiting until the end will not allow you time to get feedback from the teaching assistant on how you are progressing.

Please note that all assignments, without exception, are due on 10/29/1999. Absolutely *no* assignments will be accepted for credit after the close of class on 10/29/1999. If you do not have a preference on what order you complete these assignments in, just complete them in the order in which they are listed in the courseware.

Table 16. Due Dates for Treatment R of Pilot Study

Assignment	Points	Recommended Due Date
Text		
template.htm	1	10/8/1999
index.htm	2	10/8/1999
personal.htm	2	10/8/1999
Lists	2	*
Images	2	*
Tables	2	*
Frames	2	*
Forms	2	*
JavaScript Lite	5	10/29/1999

*Any two of these items should be completed by 10/15/1999. Two more should be completed by 10/22/1999. The remaining one should be completed by 10/29/1999.

Absolute Due Dates and Points
(given to participants in treatment A only)

Table 17 contains a summary of the due dates and total points each assignment is worth. The deadlines are at the end of class that day and are *absolute*. An assignment absolutely will *not* be accepted for credit after its deadline. You may still show it to the teaching assistant after the deadline and receive feedback on it, but it will not earn you any points. If you do not have a preference on what order you complete these assignments in, just complete them in the order in which they are listed in the courseware.

Appendix B (Continued)

Table 17. Due Dates for Treatment A of Pilot Study

Assignment	Points	Due
Text		
template.htm	1	10/8/1999
index.htm	2	10/8/1999
personal.htm	2	10/8/1999
Lists	2	*
Images	2	*
Tables	2	*
Frames	2	*
Forms	2	*
JavaScript Lite	5	10/29/1999

*Any two of these items are due on 10/15/1999. Two more are due on 10/22/1999. The remaining one is due on 10/29/1999.

Appendix C
Courseware Description

Courseware on HTML 4.0 was designed for this study. It was written in HTML and JavaScript. A current version is available online at http://tarski.math.usf.edu/˜tmajchrz/IPcourse/index.htm. Version 1.1 was given to students in a pilot study. Based on observations and student comments version 1.2 was developed for the actual study, which took place during Spring 2000. This version is on the enclosed CD-ROM (see Appendix U). See Figure 29 for a screen shot of the home page for 1.2 and to see the layout of functional units. Notice that the main menu appears in a navigation bar on the left. Sound controls, back and forward navigation elements, a comment button, and a prompt area appear on the bottom. When the user is in a given section of the courseware, the main topic is highlighted in the navigation bar on the left, the title for the section appears across the top along with the page number, and the middle portion of the window is reserved for content. See Figure 30 for an example.

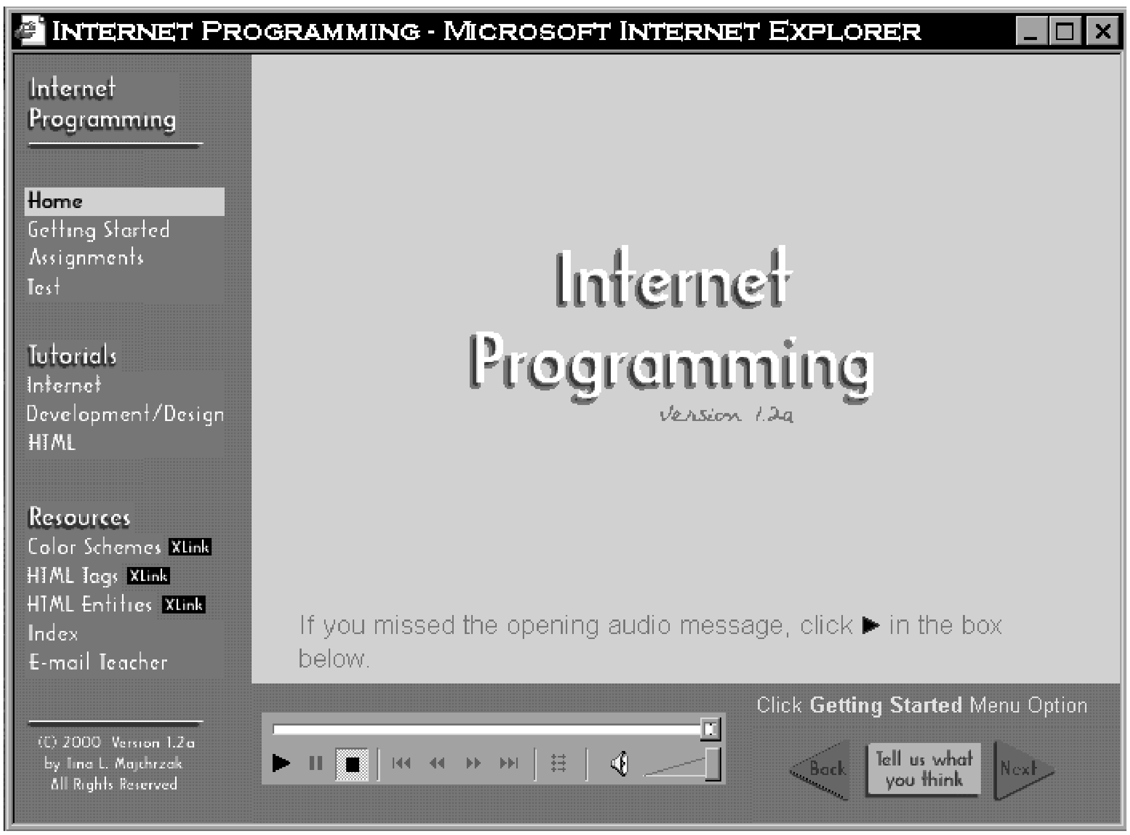

Figure 29. Home page for version 1.2 of courseware.

In general, the courseware incorporates elements of active learning and keeps individual lessons short. The narration for each lesson is under 11 minutes. In addition, students are encouraged during lessons to try out new knowledge directly

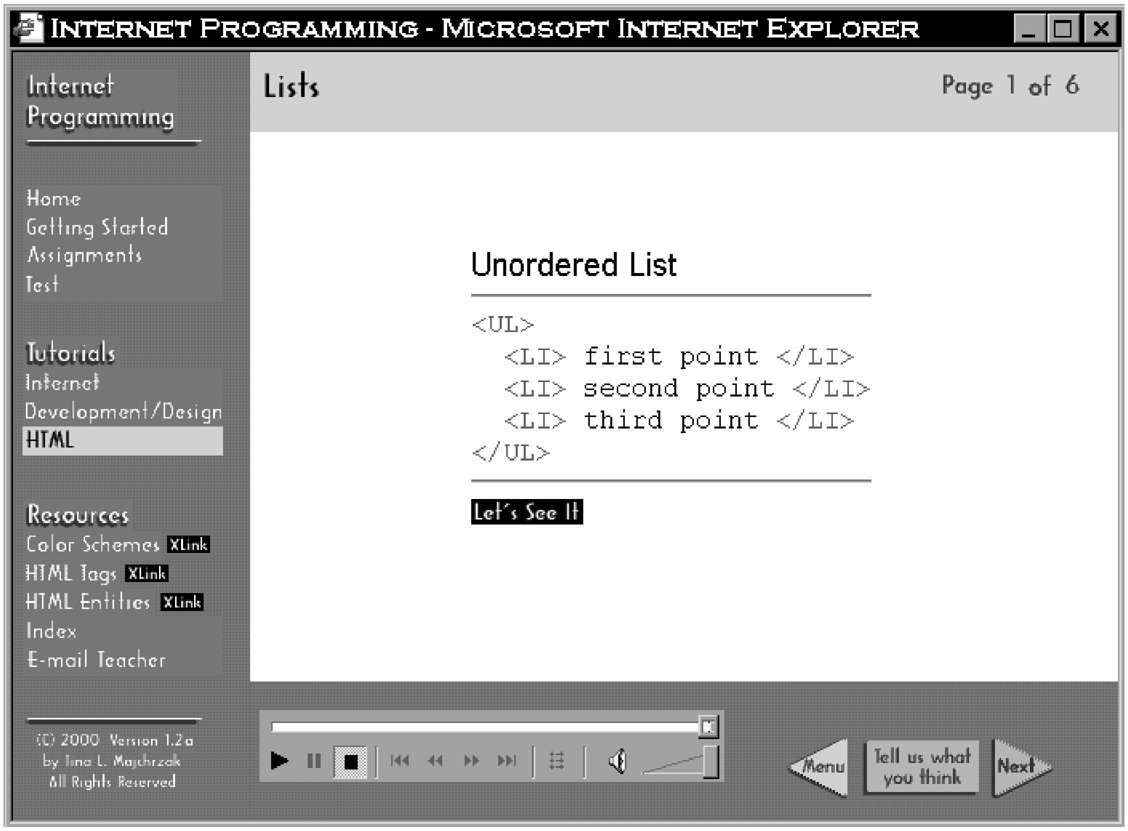

Figure 30. First page of section on lists in HTML tutorial

in the courseware. They are provided with a textbox in which to experiment, directions on what to try, and a button to click when ready to view the results. See Figure 31 for an example of such an active learning opportunity, where the student is asked to experiment with the width and height of an image. Figure 32 shows the window that pops up when the *Let's See It* button is clicked after a width of 67 and a height of 66 are specified. Figure 33 shows how the image looks for a width of 35 and a height of 66.

Other aspects of the courseware are discussed in more detail in the sections that follow. Changes inspired by the pilot study are described first. Next the courseware objectives, lessons, assignments, and system requirements are discussed for version 1.2.

Appendix C (Continued)

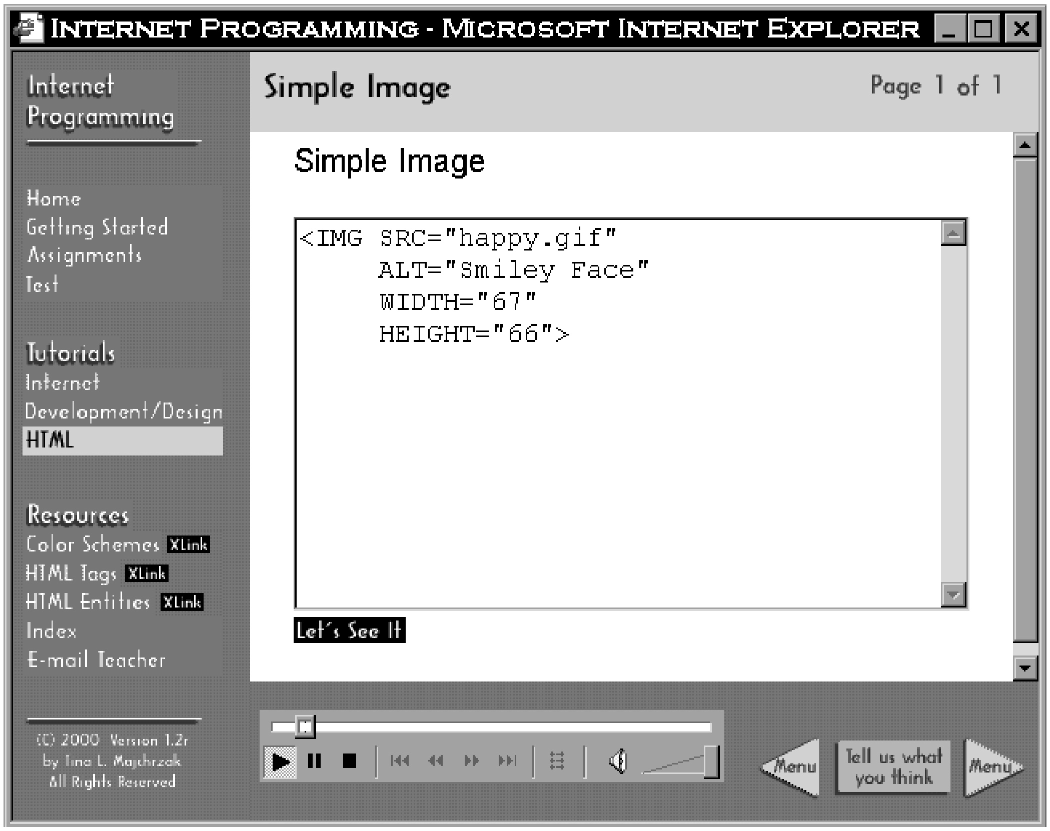

Figure 31. Active learning opportunity. The student is asked to experiment with the width of the image generated by the given HTML code. When the student clicks the *Let's See It* button, another window pops up displaying the image.

Changes Inspired by Pilot Study

Six students from the pilot study, three from each of the two deadline contingencies, were selected randomly and interviewed on the last day of the study. Several changes to the courseware were prompted by their responses. The free-response questions posed and their answers appear below. In the case when the same response was made by more than one student, the total number giving that response appears in parentheses after it.

Appendix C (Continued)

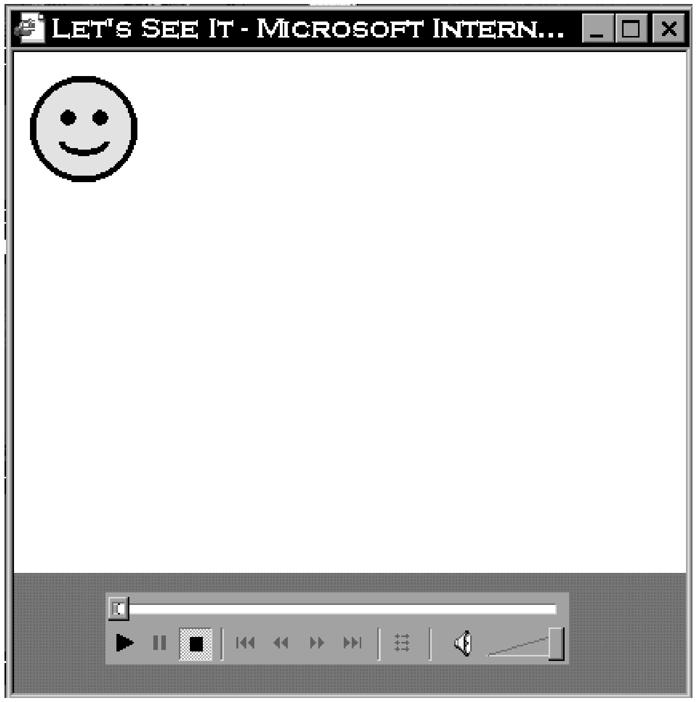

Figure 32. Image displayed for a width of 67.

1. How difficult was it to figure out how to get around in the courseware initially?

    - Very hard
    - Hard (3)
    - Easy
    - Very easy

2. How hard is to get around in now?

    - Tags and attributes harder
    - Hard, but easier
    - Enjoy now
    - Easy
    - A lot easier
    - Fairly easy

Appendix C (Continued)

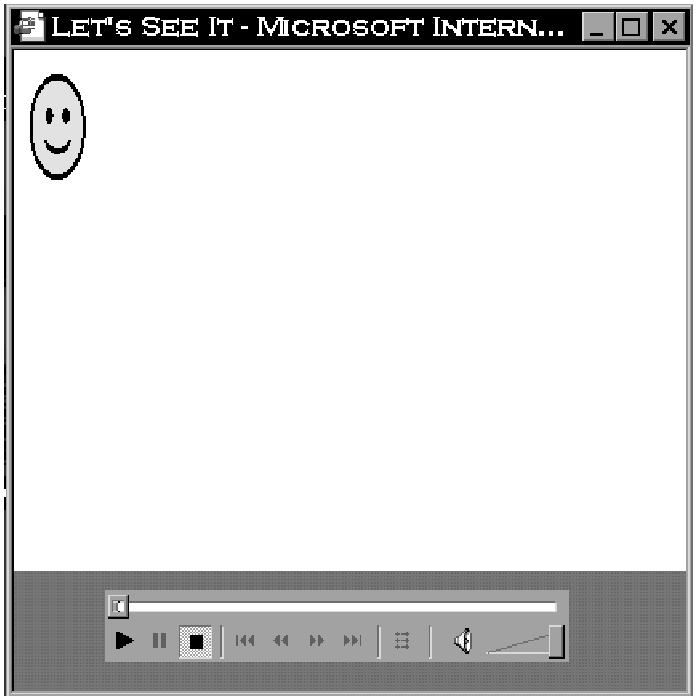

Figure 33. Image displayed for a width of 35.

3. How did you end up navigating the site (assignment description or tutorial first)?
    - Assignment first (3)
    - Tutorial first (3)

4. Did you know you could ask questions while going through the courseware?
    - No
    - No, would have helped
    - Yes (4)

Appendix C (Continued)

5. How useful were the timings? Did they seem to match the length of time it took you?

   - Did not see (2)
   - Did not use (2)
   - Useful, seemed to match
   - Useful, not sure about match but gave relative information

6. Would you recommend any navigational changes?

   - None (4)
   - Link from assignment to relevant tutorial
   - Easy to forget where you saw it; add index

7. Did the deadlines seem spaced about right?

   - Ignored, because had 20 points already (2)
   - Too fast (2)
   - Last couple too fast
   - About right

8. How many hours per week did you work on the assignments outside of class? (Note that the responses average to three-fourths of an hour.)

   - Zero (3)
   - One (2)
   - Two and one-half

9. Would you find a graphical grading rubric like the teacher's easier to use than the grading rubric list provided in the courseware?

   - Yes (3)
   - No (2)
   - Want both

10. Are there any other changes you would recommend for the courseware, lab experience, assignments, etc.? (Note that similar responses are grouped together.)

    - Augment courseware
        - Make objectives more clear in beginning
        - Help getting started on first assignment
        - Include glossary
    - Increase flexibility of access
        - Five days in a row rather than one day per week
        - Access to sound at home
        - One and one-half hours per week at anytime or sound at home
        - Eight weeks, rather than six
    - Facilitate note taking
        - Encourage note taking
        - Provide workbook or place to take notes
        - Paper copy of assignments
    - Liked *Let's See It!* opportunities to experiment

In version 1.1 of the courseware, a menu on the left containing links to assignment descriptions and tutorials allowed users to move back and forth between these items. In 1.2 that menu still exists, but navigation was augmented with direct links from assignment descriptions to pertinent tutorials and with direct links from tutorials to assignment descriptions. This change was made in response to the comments provided by students for questions 1, 2, 3, and 6. Furthermore, in response to the comments for question 6, an index was provided to facilitate locating information.

In addition to the index link added to the main navigational menu on the left, a link to e-mail their respective TA was provided to encourage students to ask questions while reviewing the courseware material. They were also encouraged at the beginning of the courseware to visit their TA during office hours for aid if desired. Each TA was available in a designated computer laboratory for four hours per week. Each was also available in their common office a few additional hours per week.

The first set of student responses to question 10 shed light on some key information that was inadvertently left out of version 1.1. The courseware did not include formal instruction on the developmental process required to create and update a Web page using a simple text editor and a browser. This process begins with the creation of the initial document using a text editor. Then the document is viewed in a browser. Next, the creator cycles between saving changes in the editor and selecting *Reload* or *Refresh* in the browser. A formal lesson outlining this process was added to version 1.2, along with an assignment to type supplied HTML code into an editor and to view it in a browser. Due to time constraints, the addition of a glossary was left for a future version of the courseware.

Some students in the pilot study indicated they felt that portions of the HTML courseware were too fast (see responses to question 7). However, they only had access to the courseware narration for a total of six hours in the lab. They had access to an online, soundless version outside of class. Each student in the actual study was supplied with a CD-ROM containing the complete courseware. It was anticipated that having access to the courseware, including sound, on demand would give students the extra time they needed to finish the assignments and not feel rushed. It was hoped that it would provide them with desired flexibility (see second set of responses to question 10).

Responses to question 8 indicated that, on average, students each spent three-fourths of an hour per week working on the assignments outside of lab time. It was anticipated that, if the students devoted 4 hours per week (or a total of 16 hours) to the assignments, they would be able to complete them all easily. In support of this, consider only those ten students who actually completed assignments during the pilot study and table **??**, which contains a summary of the data collected regarding assignment completion dates and achievement test scores. These students were able to complete, on average, 5.3 out of 8 assignments or 66% of the assignments, with their main motivations being to earn bonus points and an intrinsic desire to learn. Because the five students interviewed from this group of ten reported working outside of class, on average, one additional hour per week, that means they were able to complete 5.3 assignments in 12 hours. Therefore, it is assumed that 16 hours should be ample time[1] for most students to complete all of the assignments, especially given the motivation to earn required class points.

A few more changes were made to version 1.2 of the courseware. Based on responses to question 9, the grading rubrics were changed from textual lists to

[1]It should be noted that this assumption was made based on data from volunteers who represented a distinct segment of the accessible population. However, it was the best evidence available at the time from which to draw such a conclusion.

graphical representations. See Figure 34 for an example of an original grading rubric list and Figure 35 for an example of a graphical grading rubric. Both rubrics offer basically the same information, but in a slightly different format. Both are augmented with the same audio information. Student responses indicated that some would find the switch to a graphical representation helpful, while no students voiced an opinion that such a change would be detrimental. Another change included a discussion of the sound timings added to an early courseware section on how to navigate the site (see Figure 36). It was hoped that students in the actual study, unlike students in the pilot study (see responses to question 5), would all notice this information and find it useful in budgeting their time. Finally, in response to the third set of comments for question 10, lessons and assignments were made available in a form that was easy to print. Each student was able to decide which portion(s) of the courseware to print, if any.

Objectives and Lessons

The main objectives covered by the courseware included learning browser basics, the development process, design and style issues, HTML document structure, how to use tags and attributes in general, how to change the appearance of text, and how to include lists, images, tables, frames, and forms on a Web page. For a more detailed listing of the courseware objectives, see Appendix D. Note that these objectives were not stated explicitly in the courseware, but rather were stated implicitly in the section that describes the overall product the students created.

A listing of the courseware lessons with their corresponding assignments and reference material appears in Figure 3. In the first lesson on development, students learned how to make changes in a text editor and how to view the results in a browser. In the lesson on design, they learned about issues such as using template files, maintaining a consistent look across pages, making text readable, and using small image files. In the lessons associated with assignment two, they learned about tags and attributes in general as well as about the overall structure of an HTML document. Next, they learned how to change the appearance of text. For assignment four, they learned how to create bulleted and numbered lists. For assignment five, they learned how to include simple images and clickable image maps on their Web pages as well as how to swap in new images dynamically. For assignments six, seven, and eight, respectively, they learned how to create tables, frames, and forms. Students who wished to learn more about a given tag and/or attribute were encouraged to utilize the reference material developed by the Web

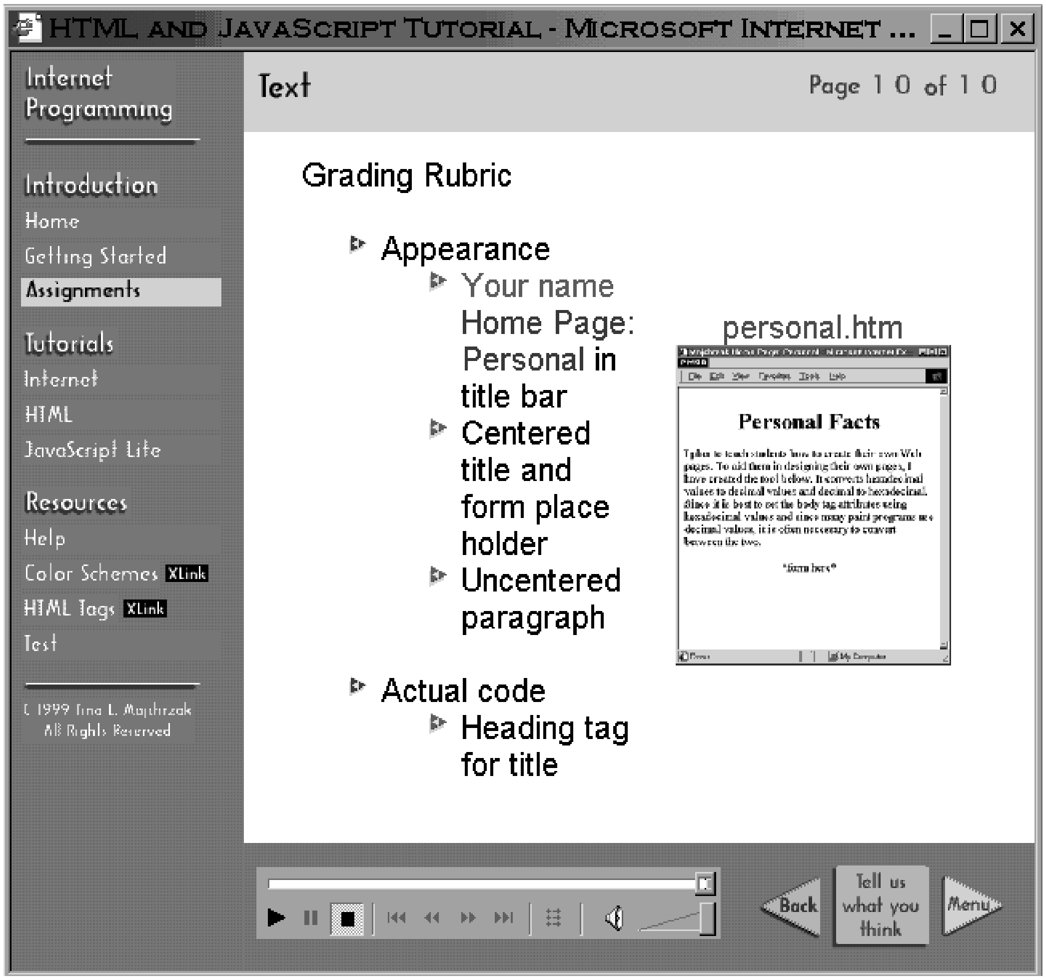

Figure 34. Grading rubric in list format.

Design Group (Quinn, 1998)[2] via convenient links next to each assignment. The material was also accessible from the courseware's main navigation bar under references. In fact, in order to complete the second assignment, students were told to look up information in this online reference. The hope was that, upon completion of the course, they would be able to explore HTML further on their own and have the skills needed to track down answers for themselves.

[2]A copy of the material was provided directly on the CD-ROM as was permitted by the original author.

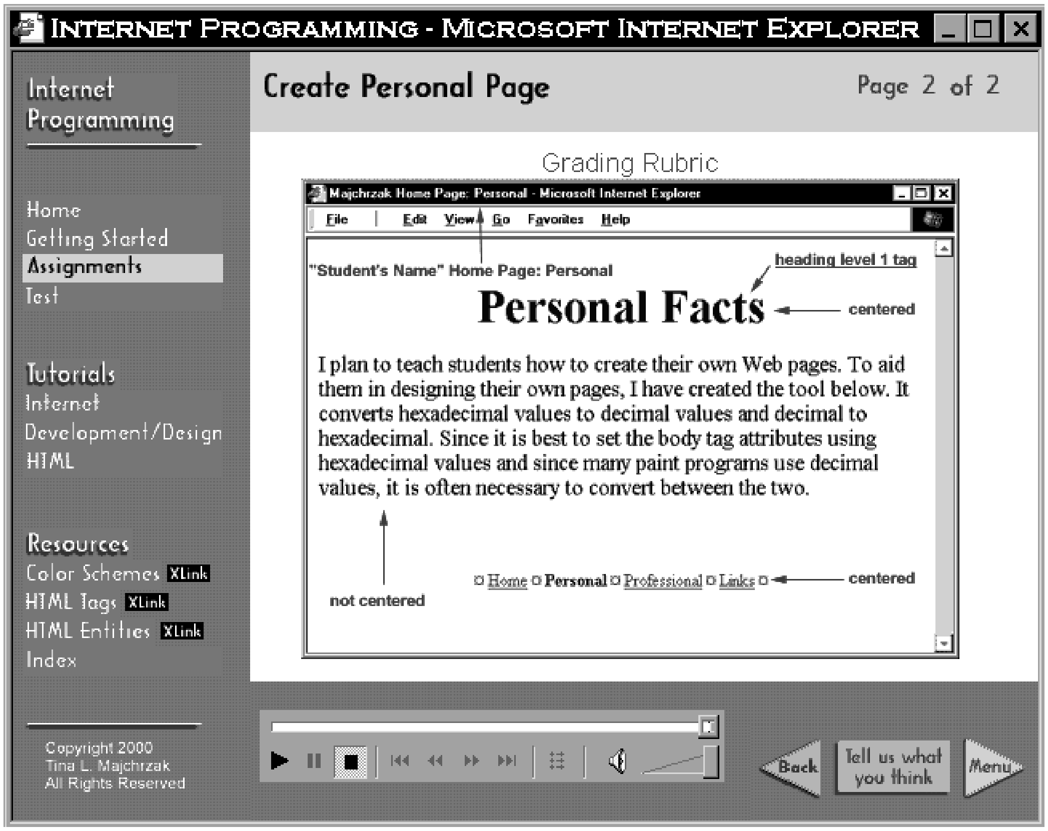

Figure 35. Grading rubric in graphical format.

Assignments

In order to obtain 100% for this portion of EdTech, which was worth 60 out of a possible 430 class points, a student needed to complete all eight of the courseware assignments (36 points) and answer all questions on a posttest correctly (24 points). Each assignment was worth 4 points, with the exception of assignment 4, which was worth 8 (see Figure **??**). Assignment 4 was worth more, because it incorporated another assignment from EdTech in which students reported information they found on ergonomics.

The eight assignments culminated in the production of a personal Web site. See Figure 37 for an overview of the site produced. A clickable image map on the initial page included links to pages containing information about a personal project, a listing of professional experience, and links to Internet sites on education and ergonomics. The entire site consisted of four Web pages, one of which

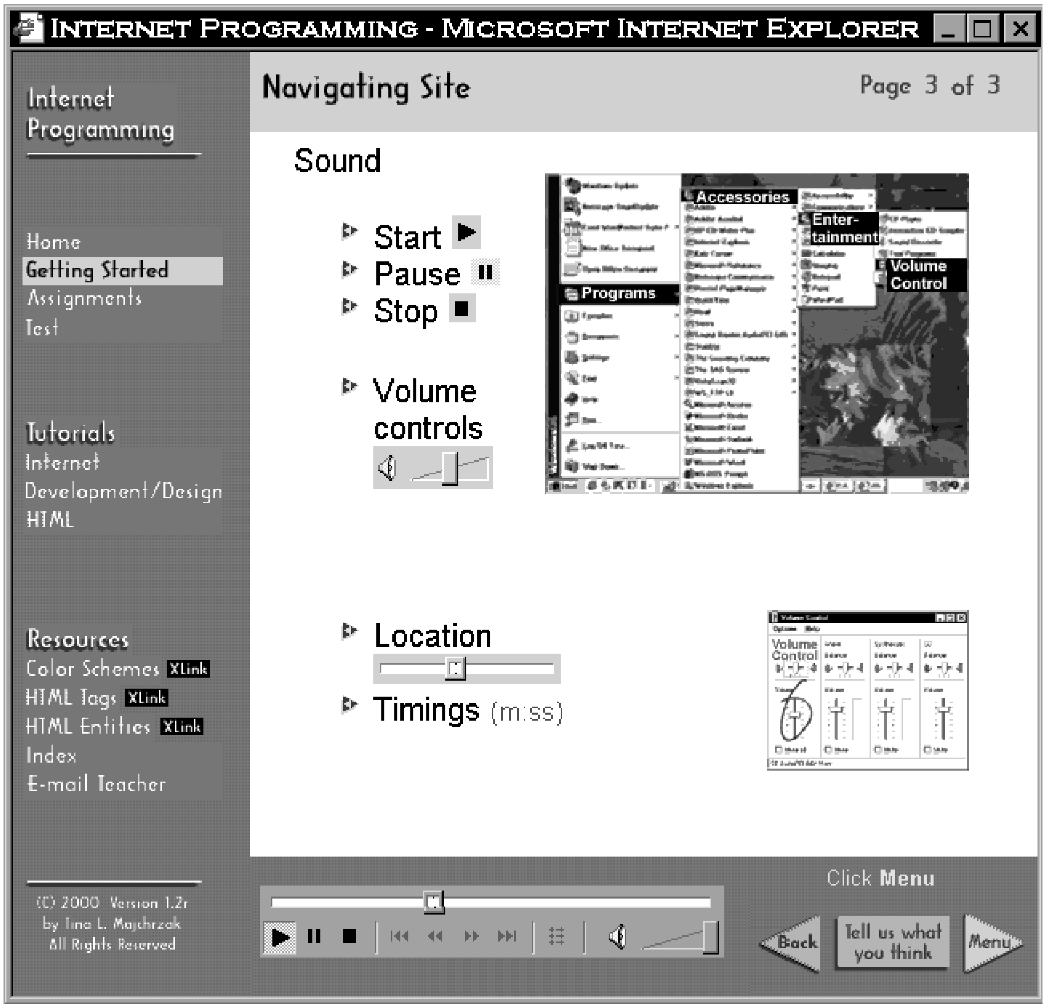

Figure 36. Courseware navigation.

was a frameset comprised of six files. In all, the students created nine files and incorporated 18 supplied images.

The first assignment familiarized them with the development process by having them type in a given HTML document. Figure 38 shows how this document, the home page for their site, should look when rendered by a browser. The second assignment required them to determine a color scheme for their site and to create a template file based on it. For assignment 3, they created an HTML document using structural and logical tags only (see Figure 39).

Assignment 4 required that they do some research. They had to locate a minimum of four Internet sites on ergonomics and to display this information as an

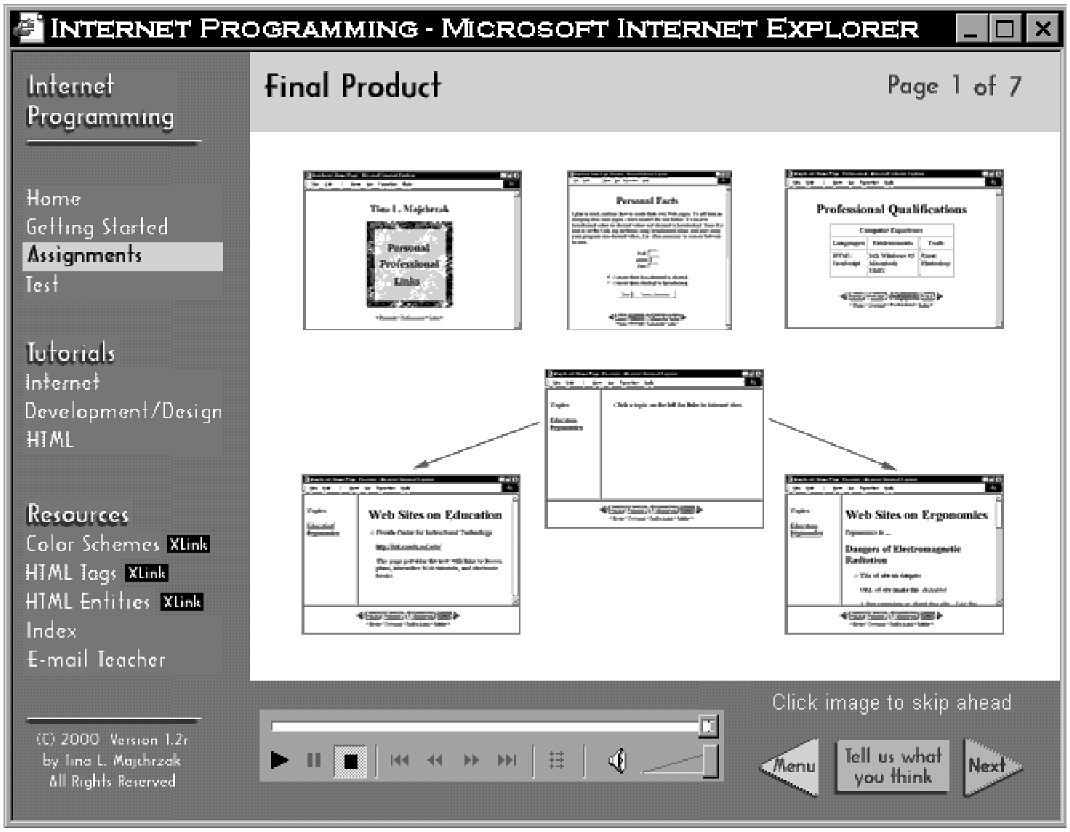

Figure 37. Overview of courseware product goal.

unbulleted list of annotated links (see Figure 40). One site needed to discuss the dangers of electromagnetic radiation. The other three needed to discuss the effects of computer use on the eyes, the arms and hands, and the skeleton as well as methods for protecting these systems.

Students added simple and clickable[3] images to their pages in assignment 5. These images were decorative as well as functional navigational elements. Swapping between them provided enhanced feedback to any site visitor who moved the mouse over them. See the enhanced documents in Figures 41 and 42. For examples of the effects of the mouseOver events, see Figures 43 and 44.

In assignment 6, they created a page that contained a table listing their professional qualifications in terms of computer experience (see Figure 45). Specifically, it contained a listing of the computer languages, environments, and tools with

[3]All coordinates for clickable regions were supplied in the courseware.

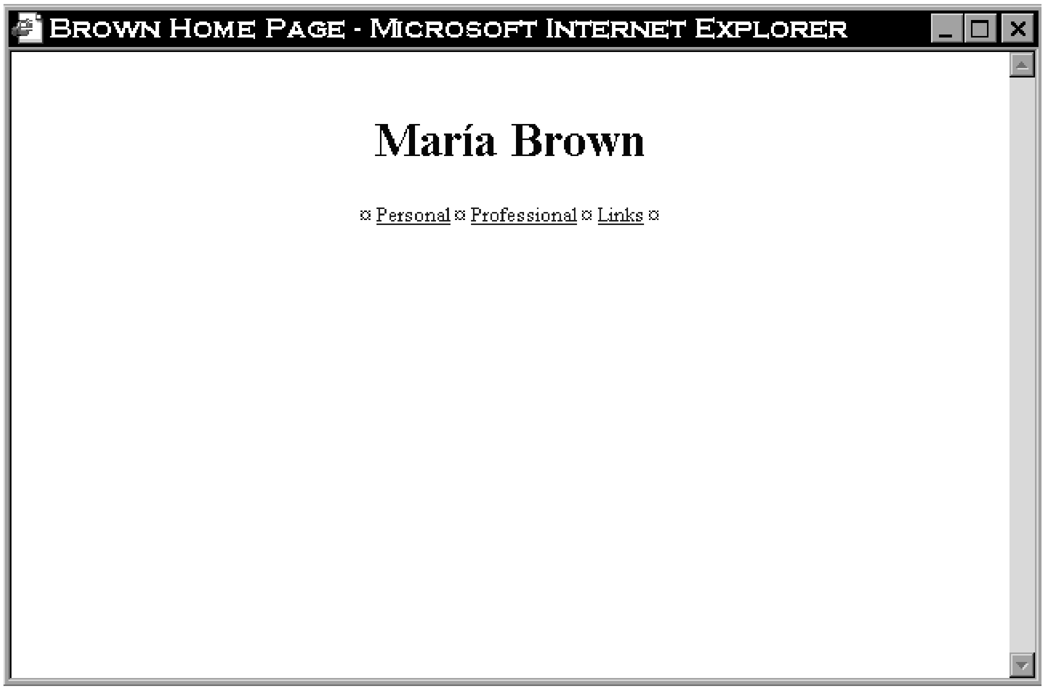

Figure 38. Initial index page of product.

which the student was familiar. In assignment 7, they updated their links page to use frames and to display educational as well as ergonomic links (see Figures 46, 47, and 48). Finally, for assignment 8, they updated their personal page by adding the form in Figure 49. It called an online cgi-script provided for the course.

System Requirements

Version 1.2 of the courseware required the use of Microsoft's Internet Explorer 4.0 or 5.0. In the case of Internet Explorer 4.0, it was further required that Microsoft's Media Player 2 be installed. The CD-ROM included instructions on how to gain access to these programs. Due to limited time and the fact that the courseware was still in an early state of development for research purposes, extensive testing on different browsers and computer platforms was not conducted. Therefore, the only browser officially supported for this version of the courseware was Internet Explorer 5.0 for Windows, although Internet Explorer 4.0 for Windows with Media Player 2 was a reasonable alternative. This was the browser of choice for two reasons. First, it played MP3 files within the browser in a consistent manner.

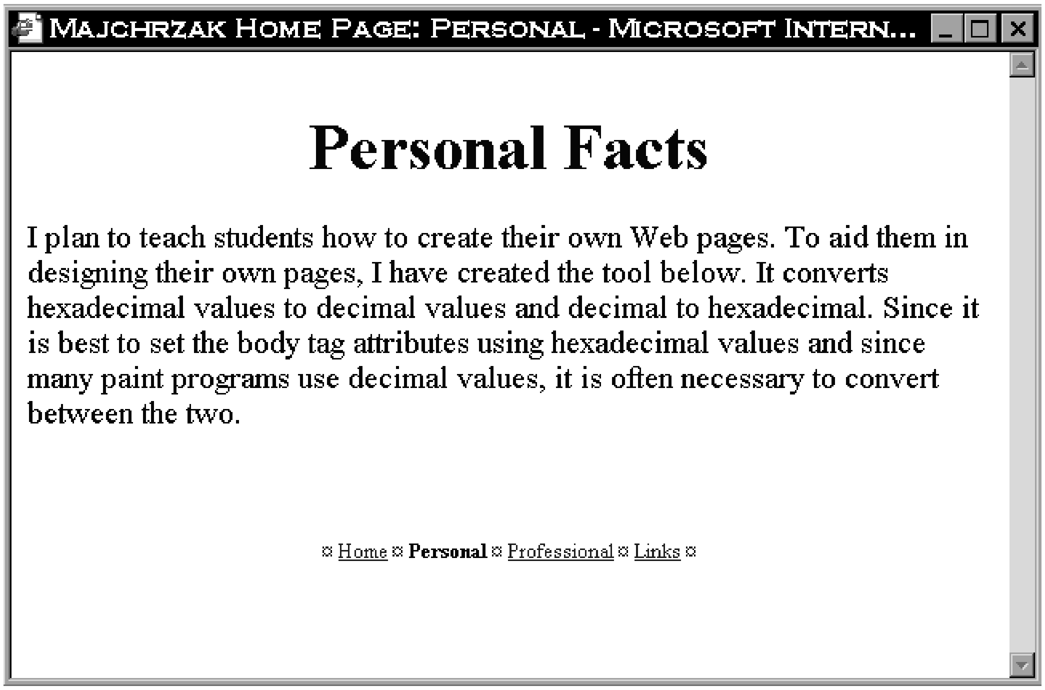

Figure 39. Initial personal page of product.

Second, the results of a survey conducted during Fall 1999 showed that the vast majority of students would have access to a Windows-based machine.

The sound files for the courseware were saved as type MP3, so that they would all fit on a single CD-ROM. The WAV versions of the sound files were too large to fit on a single CD-ROM. Internet Explorer 4.0 with Media Player 2 and Internet Explorer 5.0 (which came with Media Player 2) were the only browser/media player combinations found at the time to play the MP3 files consistently by means of a browser plugin. Other media players considered included RealPlayer G2, QuickTime 4.0, and WinAmp. None of these options had plugins that worked well consistently under Netscape 4.6 or 4.7 in tests performed. Consistent, workable plugins for Internet Explorer 4.0 and 5.0 also were not available for these alternative players. Due to the unmanageable size of the WAV sound files and the desire to have narrations play and be controlled in a consistent functional location of the courseware, as opposed to a separate window that may change locations and/or get concealed by other windows, MP3 files and the Internet Explorer/Media Player 2 combination were used. Future versions of the courseware will support alternative options as they become available and stable.

Appendix C (Continued)

Out of 233 students enrolled in EdTech during Fall 1999, 167 (71.7%) responded to a survey (see Appendix R) given on the last day of class. It requested information on the types of machines and browsers the students most often used to complete class assignments. It was assumed that students enrolled in EdTech during Spring 2000 would fit a similar profile. Based on responses, 94.6% reported that they most often used a Windows-based PC[4]. Therefore, given time constraints, rigorous testing of the courseware was confined to the Windows-based PC environment. Survey results also indicated that 29.9% of the students used some version of Netscape Navigator, 39% used some version of Internet Explorer, and an unexpected 32.3% used some version of AOL[5]. Ideally, the Netscape Navigator, Internet Explorer, and AOL browsers should all be supported. However, as mentioned above, time constraints and the lack of a viable plugin for playing MP3s inline in Netscape Navigator made it unfeasible to support this browser at this time. Upon a cursory examination, it appeared that AOL 5.0, at least, might be a viable browser option, because it played MP3s inline.

On a final note, 67.7% of the students reported working at home, 19.8% reported working at an open use computer laboratory in the Education building[6], and 4.8% reported working at both locations just as often. Individual computers were checked in each lab and found to run the courseware, including narrations. Given instructions supplied with the CD-ROM, students were able to install the required browser and media player on their home systems, if necessary. If not, they had access to the machines in the computer lab until they were able to do so. Students were advised to bring headphones to the lab with them, because only ten headphones were available in the labs during the treatment interval.

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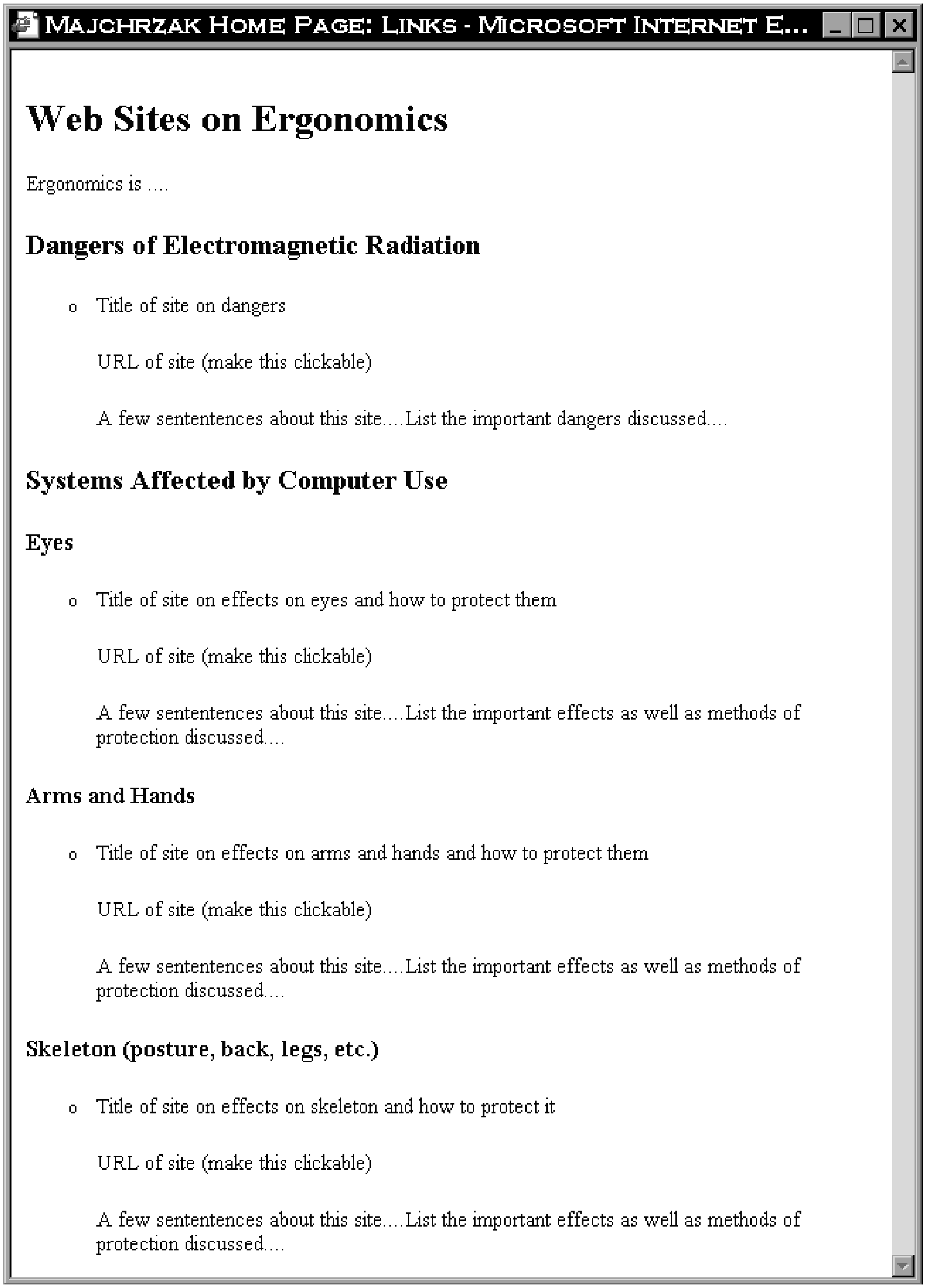
[4]One person actually reported using both a PC and a Macintosh equally often.

[5]Note that the percentages total more than 100%, because some students reported using more than one browser regularly.

[6]There were two such computer laboratories. One had 33 computers, the other 23.

Appendix C (Continued)


Majchrzak Home Page: Links - Microsoft Internet E...

Web Sites on Ergonomics

Ergonomics is ....

Dangers of Electromagnetic Radiation

- Title of site on dangers

  URL of site (make this clickable)

  A few sententences about this site....List the important dangers discussed....

Systems Affected by Computer Use

Eyes

- Title of site on effects on eyes and how to protect them

  URL of site (make this clickable)

  A few sententences about this site....List the important effects as well as methods of protection discussed....

Arms and Hands

- Title of site on effects on arms and hands and how to protect them

  URL of site (make this clickable)

  A few sententences about this site....List the important effects as well as methods of protection discussed....

Skeleton (posture, back, legs, etc.)

- Title of site on effects on skeleton and how to protect it

  URL of site (make this clickable)

  A few sententences about this site....List the important effects as well as methods of protection discussed....

Figure 40. Initial links page of product.

Appendix C (Continued)

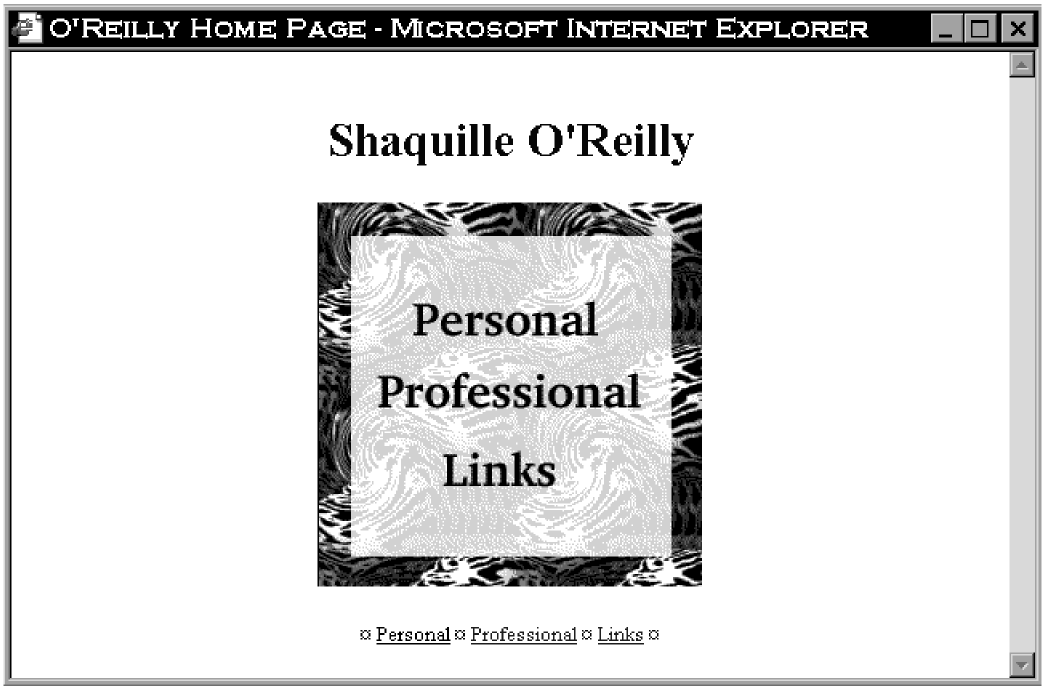


Figure 41. Index page of product with clickable image.

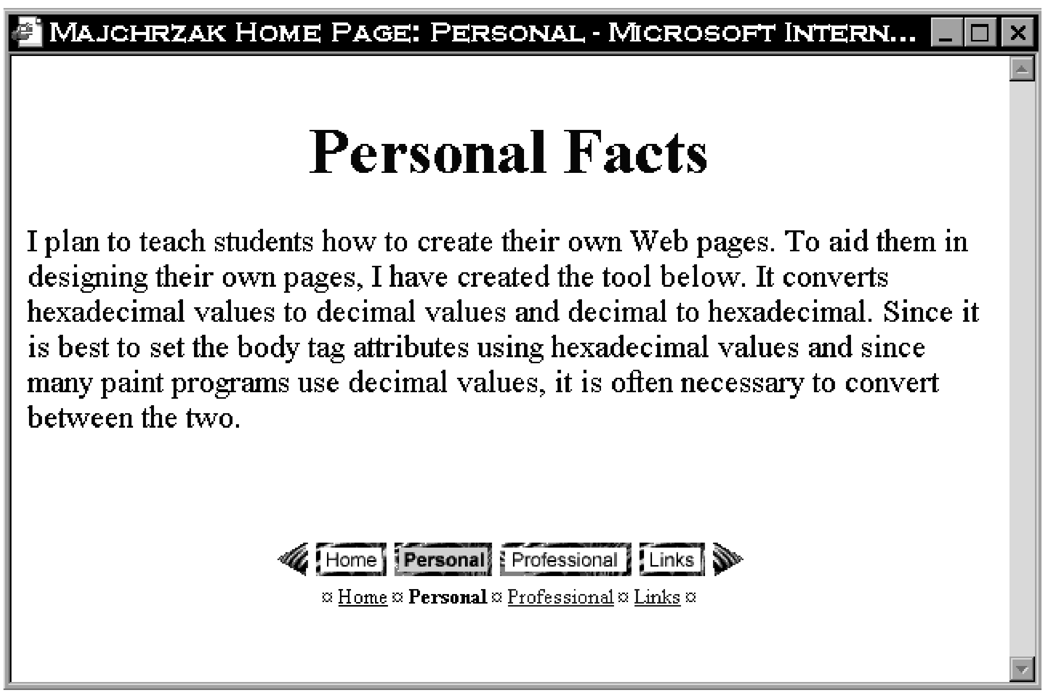


Figure 42. Personal page of product with navigational images.

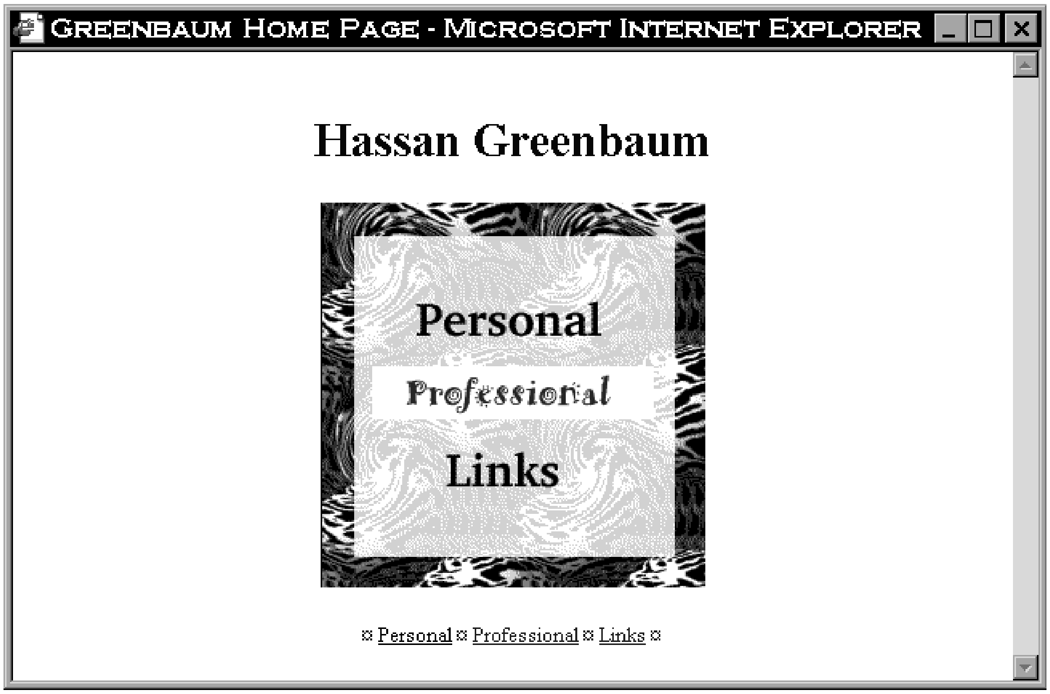


Figure 43. Index page of product with mouse over professional.

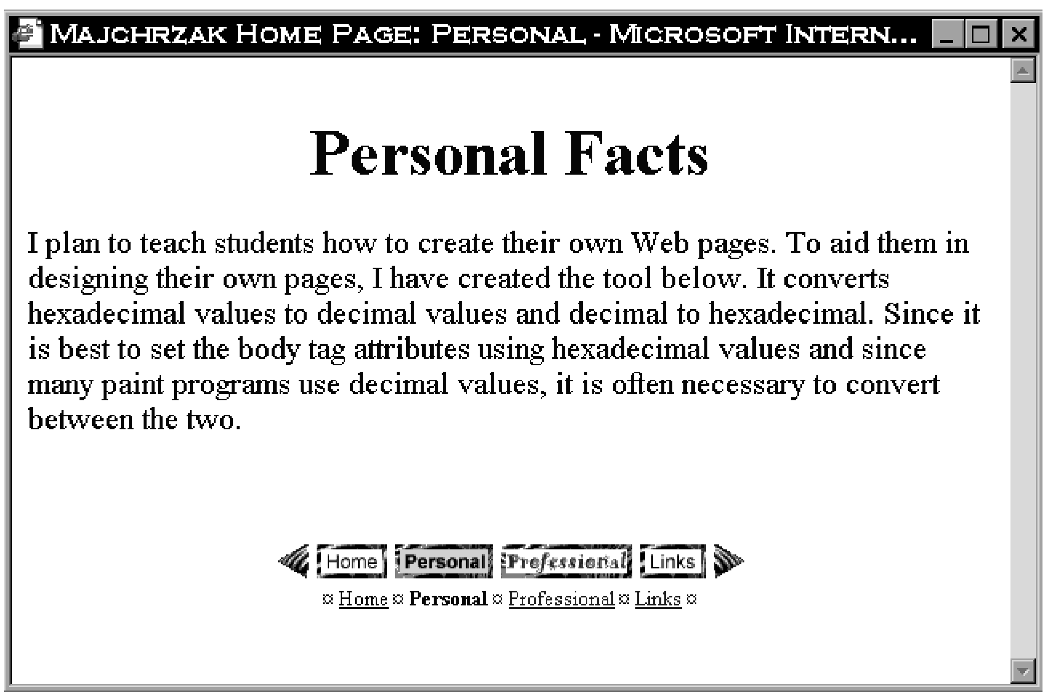


Figure 44. Personal page of product with mouse over professional.

Appendix C (Continued)

Figure 45. Professional page of product.

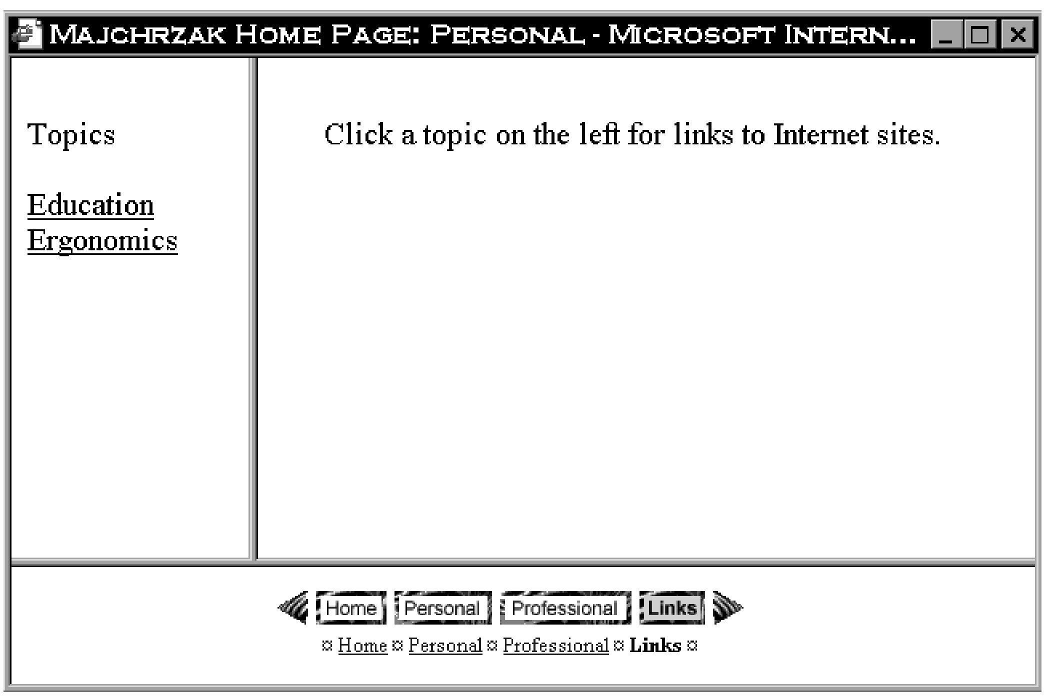


Figure 46. Initial frames for links page of product.

Appendix C (Continued)

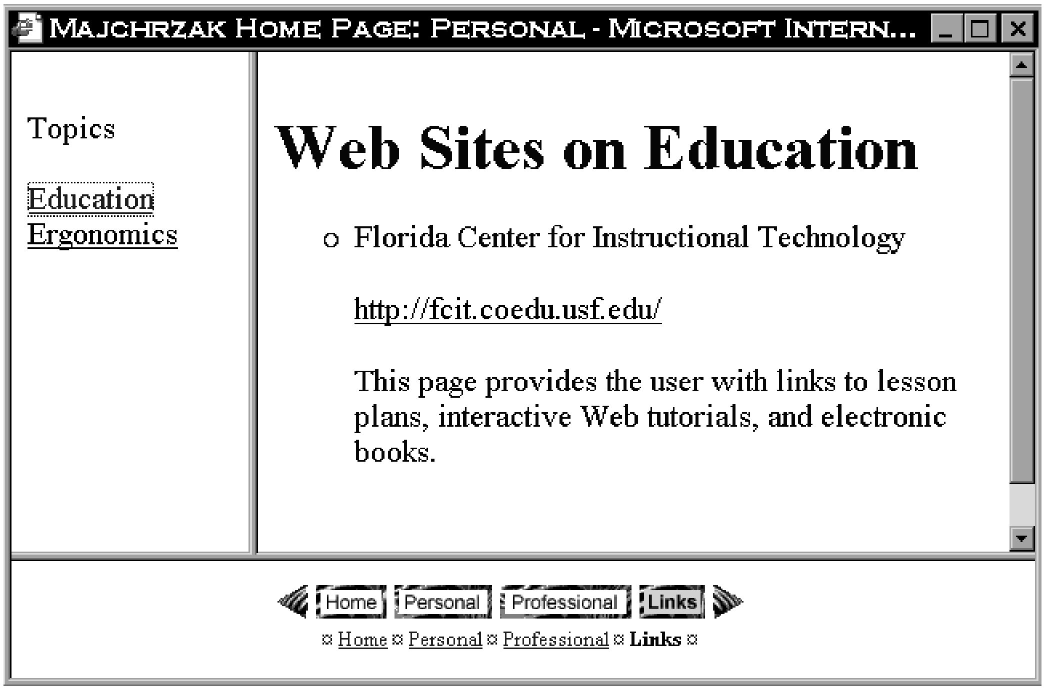


Figure 47. Frames for links page of product after clicking education.

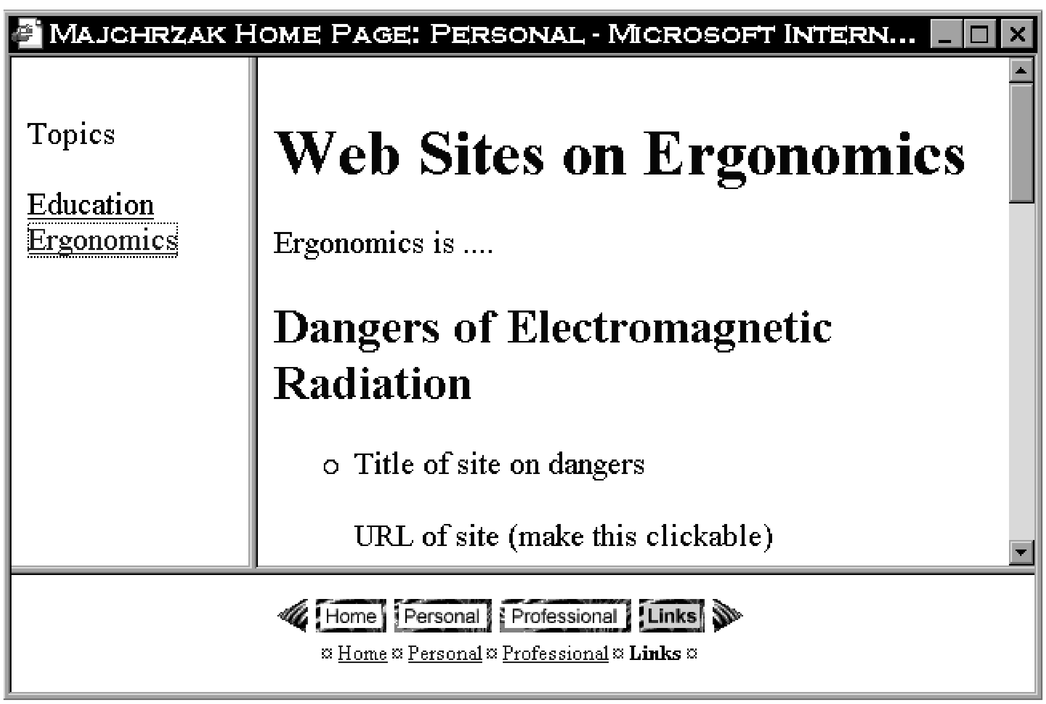


Figure 48. Frames for links page of product after clicking ergonomics.

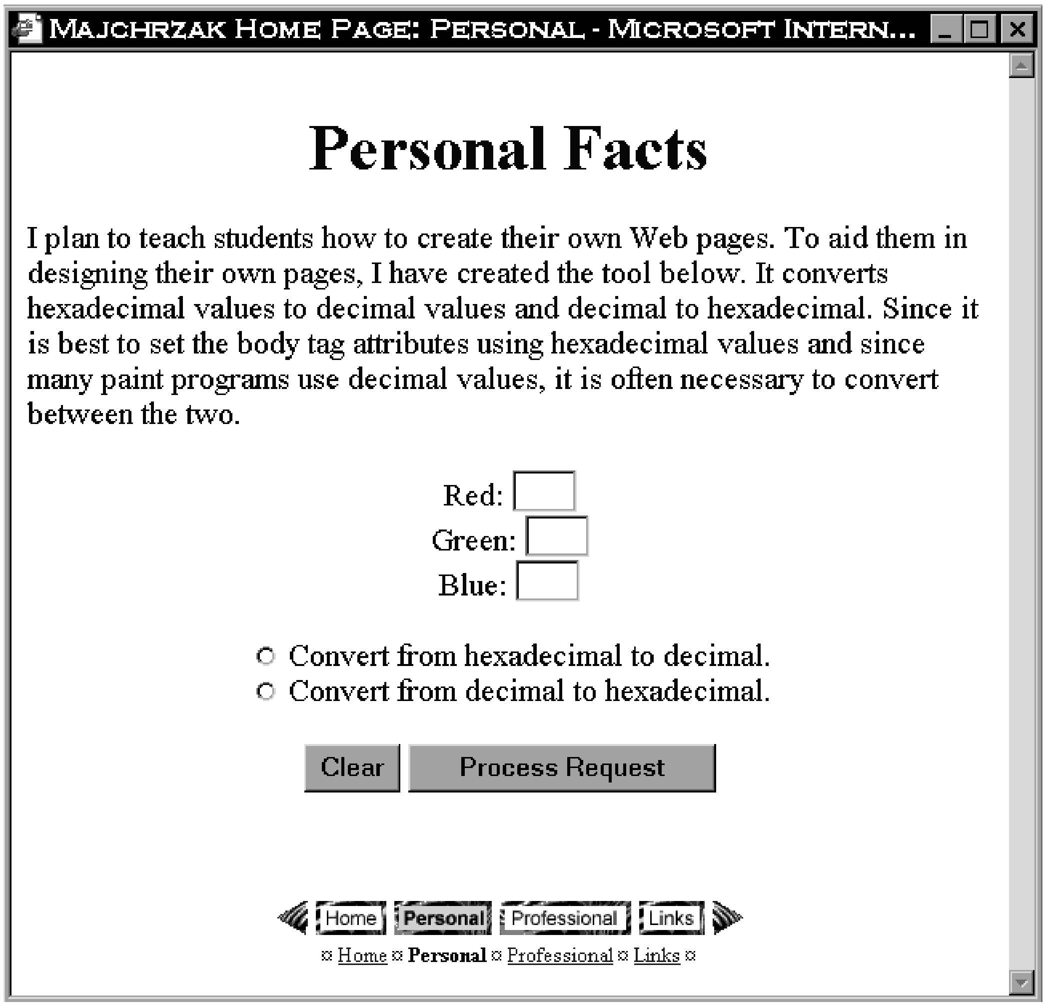


Figure 49. Personal page of product with form.

Appendix D
Courseware Objectives

The ten main objectives of the courseware are listed below. The values in brackets are the relative weightings given to each objective in terms of the number of items included on the pretest (Pre), the posttest (Post), and the retention test (Ret). Percentages are listed in parentheses. Recall that the pretest and retention test are comprised of the same 9 multiple choice items and that the retention test has an additional essay question graded based on 12 items. Recall also that there are 48 items on the posttest, which consists of 36 multiple choice questions and 1 essay question comprised of 12 items. Each essay item on the posttest was worth 4 points, while each multiple choice item was worth 1.

1. Browser Basics [1 Pre (11%), 2 Post (2%), 1 Ret (5%)]
   (a) view a page created and saved on the local machine
   (b) recognize the forgiving nature of HTML interpreters

2. Development, Design, and Style [1 Pre (11%), 3 Post (4%), 1 Ret (5%)]
   (a) understand the importance of writing readable HTML code
   (b) understand the merits of using a template file
   (c) be aware of the need to Refresh/Reload a document to see changes

3. Document Structure [0 Pre (0%), 6 Post (29%), 6 Ret (29%)]
   (a) include a link to another page
   (b) demonstrate knowledge that HTML documents are comprised of two main sections, the HEAD and the BODY
   (c) demonstrate knowledge that HTML documents are designated with opening and closing HTML tags that surround the content

4. Tags and Attributes [1 Pre (11%), 7 Post (26%), 6 Ret (29%)]
   (a) use tags and attributes correctly
   (b) demonstrate an understanding of how tags and attributes work by being able to look up and use tags and attributes not discussed formally in the courseware
   (c) set the title displayed in the title bar of the browser
   (d) set the background, text, and link colors

Appendix D (Continued)

5. Text Style [1 Pre (11%), 5 Post (11%), 2 Ret (10%)]
   (a) physically markup text (bold, change relative font size)
   (b) logically markup text (heading level)
   (c) center text

6. Lists [1 Pre (11%), 5 Post (6%), 1 Ret (5%)]
   (a) include an ordered (numbered) or unordered (bulleted) list
   (b) include a number or bullet
   (c) set the bullet type for a bulleted list

7. Images [1 Pre (11%), 5 Post (6%), 1 Ret (5%)]
   (a) include a simple image
   (b) appropriately set the COORDS attribute of the AREA tag in a client-side image map, given coordinates for a clickable region on an image
   (c) turn off the border for a clickable image
   (d) use the mouseOver and mouseOut attributes of the IMG tag

8. Tables [1 Pre (11%), 5 Post (6%), 1 Ret (5%)]
   (a) use the rowspan, nowrap, and valign cell attributes
   (b) set the attributes of a table
   (c) designate table rows
   (d) designate header and data cells

9. Frames [1 Pre (11%), 5 Post (6%), 1 Ret (5%)]
   (a) create a frames version of a Web site
   (b) set the target of a link to a specific frame, to the top level window, or to a new window
   (c) use the NOFRAMES tag to display alternative content

10. Forms [1 Pre (11%), 5 Post (6%), 1 Ret (5%)]
    (a) include an INPUT element of TYPE text
    (b) include an INPUT element of TYPE radio
    (c) include an INPUT element of TYPE reset
    (d) include an INPUT element of TYPE submit
    (e) call a cgi-script to process the information in specific form elements

Appendix E
Annotated Items from all Achievement Measures

Key to Marginal Notes

Objective	courseware objective tested by item
Ex1	alternative objective identified by first expert
Ex2	alternative objective identified by second expert
Pilot	included on pilot posttest
Pre / Ret	included on pretest and retention test
Post	included on posttest
$\boxed{\text{response}}$	correct answer

1. You may use a Web browser to view which of the following? — Objective 1a; Post

   (a) $\boxed{\text{all of the following}}$

   (b) online documents saved on a Web server

   (c) offline documents saved on the local machine

   (d) the source of an HTML document

2. In general, what will a browser do with a tag it does not recognize? — Objective 1b; Ex2: 4a; Pre / Ret; Pilot

   (a) report an error

   (b) $\boxed{\text{ignore it}}$

   (c) replace it with a close match

   (d) fix it

Appendix E (Continued)

3. While not technically correct (according to the HTML 4.0 specification), browsers will generally allow you to do which of the following and still render your page as requested? — Objective 1b Post

   (a) $\boxed{\text{more than one of the following}}$

   (b) <B><I>text</B></I>
   (should be: <B><I>text</I></B>)

   (c) <BODY TEXT="gray"> text </BODY TEXT="gray">
   (should be: <BODY TEXT="gray"> text </BODY>)

   (d) <HR>text</HR>
   (should be: <HR>text)

4. Future changes to your HTML document will be facilitated by doing which of the following? — Objective 2a Pre / Ret

   (a) using appropriate colors for the text and links

   (b) making the size of images small, so they download faster

   (c) $\boxed{\text{using ample white space and indenting}}$

   (d) using tables to layout elements

5. When writing HTML code, using ample white space (spaces, tabs, blank lines) and lining up end tags under start tags allows ____________ . — Objective 2a Post

   (a) more than one of the following

   (b) a browser to process the code more quickly

   (c) a browser to determine if any tags are missing more easily

   (d) $\boxed{\text{a human to make future changes to the code more easily}}$

Appendix E (Continued)

6. It is advisable to use a template file for the following reason(s).

   Objective 2b
   Post

   (a) all of the following

   (b) User's will not be able to view your index page without one.

   (c) It will reduce the amount of time the user must wait to view HTML documents at your Web site.

   (d) It will speed production of future HTML documents for your Web site.

7. In order to view changes to an HTML document that is currently displayed by the browser, what must you do? Note that the changes were made after the document was opened in the browser.

   Objective 2c
   Post

   (a) You need do nothing, since the browser display will automatically be updated.

   (b) You need to click the *Back* button on the browser.

   (c) You need to click the *Reload* or *Refresh* button on the browser.

   (d) You need to click the *Forward* button on the browser.

8. Given the tag specification <TD> [</TD>], where the brackets indicate that this part is optional, which of the following would be valid ways to use this tag?

   Objective 4a
   Ex2: 3c, 4a
   Pre / Ret
   Pilot

   (a) more than one of the following

   (b) <TD>text

   (c) <TD>text</TD>

   (d) </TD>text<TD>

Appendix E (Continued)

9. Given the tag specification <I></I>, which of the following would be valid ways to use this tag?

    (a) more than one of the following

    (b) <I>text

    (c) <I>text</I>

    (d) </I>text<I>

Objective 4a
Ex1: 4a, 5a
Ex2: 3c, 4a
Post
Pilot

10. Given the start tag <FONT SIZE="+1">, what should the end tag look like?

    (a) more than one of the following

    (b) </FONT SIZE="+1">

    (c) </FONT SIZE="-1">

    (d) </FONT>

Objective 4a
Ex1: 5a, 4a
Ex2: 5a, 3c
Post
Pilot

11. Which tag is used to mark text as bold?

    (a) B

    (b) D

    (c) BOLD

    (d) DARK

Objective 5a
Post
Pilot

12. Which tag must all browsers render the same?

Objective 5a
Post
Pilot

(a) STRONG

(b) EM

(c) $\boxed{\text{I}}$

(d) KBD

13. Which tag allows you to specify either an exact or a relative size for text?

Objective 5a
Pre / Ret

(a) SMALL

(b) $\boxed{\text{FONT}}$

(c) BIG

(d) REL

14. Different browsers may render which of the following tags as they see fit?

Objective 5b
Ex1: 5a
Ex2: 5a
Post

(a) I

(b) TT

(c) $\boxed{\text{EM}}$

(d) U

Appendix E (Continued)

15. Which heading level tag will be displayed most prominently? — Objective 5b, Post
    - (a) HR
    - (b) H0
    - (c) $\boxed{\text{H2}}$
    - (d) H6

16. Which tag is used to create a bulleted list? — Objective 6a, Pre / Ret
    - (a) $\boxed{\text{UL}}$
    - (b) OL
    - (c) LI
    - (d) BI

17. Which tag is used to create a numbered list? — Objective 6a, Post
    - (a) LI
    - (b) LN
    - (c) NL
    - (d) $\boxed{\text{OL}}$

18. What is the minimum number of opening UL tags required for a list with 3 bullets? — Objective 6a, Ex2: 6b, Post
    - (a) $\boxed{1}$
    - (b) 2
    - (c) 3
    - (d) 4

Appendix E (Continued)

19. What is the minimum number of opening LI tags required for a list with 3 bullets? — Objective 6b, Post

    (a) 1

    (b) 2

    (c) $\boxed{3}$

    (d) 4

20. Which tag causes the browser to display a bullet or number (depending on the kind of list in which it is used)? — Objective 6b, Post, Pilot

    (a) OL

    (b) UL

    (c) $\boxed{\text{LI}}$

    (d) TYPE

21. Which attribute is used to change the look of a bullet? — Objective 6c, Post, Pilot

    (a) VALUE

    (b) $\boxed{\text{TYPE}}$

    (c) LOOK

    (d) NAME

22. Which attribute of the image tag is used to specify what nongraphical browsers will see and what graphical browsers see while waiting for the image to download?

Objective 7a
Post

(a) BORDER

(b) BOX

(c) SUBJECT

(d) $\boxed{\text{ALT}}$

23. On a page that includes an image with text following it, the text that follows may or may not appear to download at a different rate of speed when the width and height of the image are specified. Will that rate be faster, slower, the same, or depend on the size of the image?

Objective 7a
Post

(a) $\boxed{\text{faster}}$

(b) slower

(c) same

(d) depends on image size

24. If you want to have an image on your Web page with an actual width of 28 pixels download and display faster for the user, what should you do?

Objective 7a
Pre / Ret

(a) more than one of the following

(b) specify a width of 14 pixels when including it on your page

(c) do not specify a width or height for the image

(d) $\boxed{\text{open the image in an image editor and make it smaller}}$

25. In the image coordinate system, where is the origin (0,0) for the image? (a) center (b) $\boxed{\text{top, left}}$ (c) top, right (d) bottom, left	Objective 7b Post Pilot
26. Which attribute of the image tag must be set to 0 to disable the box that appears around a clickable image? (a) $\boxed{\text{BORDER}}$ (b) BOX (c) SUBJECT (d) ALT	Objective 7c Post
27. Which image attribute do you change to bring in a different image? (a) IMG (b) ALT (c) NEW (d) $\boxed{\text{SRC}}$	Objective 7d Post Pilot

28. Which of the following attributes is NOT defined for a table cell?

    (a) NOWRAP

    (b) COLSPAN

    (c) $\boxed{\text{WRAPSPAN}}$

    (d) ROWSPAN

Objective 8a
Ex1: 8a, 8b
Ex2: 8d
Post
Pilot

29. Which cell alignments are possible in a table?

    (a) $\boxed{\text{more than one of the following}}$

    (b) vertical

    (c) horizontal

    (d) angled

Objective 8a
Ex1: 8b
Ex2: 8b, 8a
Post
Pilot

30. Which table attribute increases the distance BETWEEN cells?

    (a) WIDTH

    (b) BORDER

    (c) CELLPADDING

    (d) $\boxed{\text{CELLSPACING}}$

Objective 8b
Post
Pilot

31. Which table tag designates a row? — Objective 8c, Post, Pilot

    (a) more than one of the following

    (b) $\boxed{\text{TR}}$

    (c) TD

    (d) TH

32. Which table tag designates a cell in a row? — Objective 8d, Post, Pilot

    (a) $\boxed{\text{more than one of the following}}$

    (b) TR

    (c) TD

    (d) TH

33. Which table tag makes text appear strongly emphasized (bold in some browsers)? — Objective 8d, Pre / Ret, Pilot

    (a) more than one of the following

    (b) TR

    (c) TD

    (d) $\boxed{\text{TH}}$

34. How would you specify in a FRAMESET tag that you would like two rows with the top row containing a frame of height 50 pixels? — Objective 9a, Post

    (a) ROWS="*,50%"

    (b) ROWS="50%,*"

    (c) $\boxed{\text{ROWS="50,*"}}$

    (d) ROWS="*,50"

35. FRAMESET tags can be ___________ . — Objective 9a, Post

   (a) overlayed

   (b) $\boxed{\text{nested}}$

   (c) shifted

   (d) split

36. What should you set the TARGET attribute of the A tag to, if you want a new browser window to be opened when the corresponding link is clicked? — Objective 9b, Ex2: 4a, Post, Pilot

   (a) $\boxed{\text{_blank}}$

   (b) _window

   (c) _top

   (d) _new

37. What attribute of the FRAME tag must be set in order to use it as a target for A tags? — Objective 9b, Post

   (a) TARGET

   (b) $\boxed{\text{NAME}}$

   (c) SRC

   (d) HREF

38. What should you set the TARGET attribute of the A tag to, if you want the new page displayed after clicking a link in a frame to wipe out all frames and be displayed in the entire original browser window? — Objective 9b, Pre / Ret

    (a) _blank

    (b) _window

    (c) $\boxed{\text{\_top}}$

    (d) _new

39. It is possible to supply alternative content in your frameset for browsers that are unable to ____________ . — Objective 9c, Post

    (a) view images

    (b) $\boxed{\text{load frames}}$

    (c) frame images

    (d) view targets

40. Which attribute is used with form INPUT of type text to limit the amount of data that the user is allowed to type into the textfield? — Objective 10a, Post

    (a) LIMIT

    (b) TYPE

    (c) SIZE

    (d) $\boxed{\text{MAXLENGTH}}$

41. Which form element(s) can be used to allow only one item in a group to be checked? — Objective 10b, Pre / Ret

    (a) $\boxed{\text{radio buttons}}$

    (b) group buttons

    (c) checkboxes

    (d) groupboxes

42. In order for form elements of type radio to work together, they must all have the same value for which attribute? — Objective 10b, Post, Pilot

    (a) VALUE

    (b) $\boxed{\text{NAME}}$

    (c) SYNC

    (d) CHECKED

43. What does the reset form element do? — Objective 10c, Post

    (a) reloads the page

    (b) sets all form elements to blank states

    (c) reloads the frame currently selected

    (d) $\boxed{\text{sets all form elements to original states}}$

44. It is possible to change the ____________ a submit button. — Objective 10d, Post

    (a) range of

    (b) $\boxed{\text{message displayed on}}$

    (c) source referenced on

    (d) type of

45. When information supplied by the user via a form element in an HTML document is to be sent to and processed by a cgi-script, it is necessary to set which attribute of the element appropriately, so that the script can access the information? — Objective 10e Post

    (a) SIZE

    (b) NAME

    (c) SRC

    (d) ACCEPT

46. Write a complete HTML document that includes the following elements. See Figure 50 for a screen capture of how your code should be rendered by a particular browser. (12 points) Post

- “My Page” appears in the title bar.
- The background color is white, the text color is black, and the visited and unvisited link colors are blue.
- Two centered horizontal rules span 50% of the screen. (If necessary, refer to the reference material on BODY and HR provided on pages 171 and 172.)
- The page contains the sentence “Check out my Web site!”, where the phrase “my Web site” is a link that, when clicked, opens the file “index.htm”.

Figure 50. HTML code rendered by Internet Explorer (posttest).

BODY - Document Body - Microsoft Internet Explorer

BODY - Document Body

Syntax <BODY>...</BODY>

Attribute Specifications

- BACKGROUND=*URI* (background image for document)
- BGCOLOR=*Color* (background color for document)
- TEXT=*Color* (text color for document)
- LINK=*Color* (link color for document)
- VLINK=*Color* (visited link color for document)
- ALINK=*Color* (active link color for document)
- ONLOAD=*Script* (document has been loaded)
- ONUNLOAD=*Script* (document has been exited)
- common attributes

Contents

- In HTML 4.0 Strict: one or more block-level elements or SCRIPT, INS, DEL
- In HTML 4.0 Transitional: inline elements, block-level elements, INS, DEL

Contained in

- In HTML 4.0 Strict or Transitional: HTML
- In HTML 4.0 Frameset: NOFRAMES

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BODY takes a number of attributes for specifying the background and colors of the document on visual browsers. These attributes are deprecated in HTML 4.0 in favor of style sheets, which provide greater flexibility in suggesting the presentation of a document. **BGCOLOR** suggests a background color, **TEXT** suggests a text color, **LINK** suggests a link color, **VLINK** suggests a visited link color, and **ALINK** suggests an active link color (when the link is selected). If one of these attributes is given, then all of them should be included to ensure that the user's chosen colors do not interfere with those suggested in the **<BODY>** tag. Authors should not rely on the specified colors being used since browsers allow these colors to be overridden by the user.

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WDG HTML 4.0 Reference ~ Elements by Function ~ Elements Alphabetically

HR - Horizontal Rule - Microsoft Internet Explorer

HR - Horizontal Rule

Syntax	<HR>
Attribute Specifications	▪ ALIGN=[left | center | right] (horizontal alignment) ▪ NOSHADE (solid line) ▪ SIZE=*Pixels* (line height) ▪ WIDTH=*Length* (line width) ▪ core attributes ▪ common events
Contents	Empty
Contained in	APPLET, BLOCKQUOTE, BODY, BUTTON, CENTER, DD, DEL, DIV, FIELDSET, FORM, IFRAME, INS, LI, MAP, NOFRAMES, NOSCRIPT, OBJECT, TD, TH

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HR's deprecated **ALIGN** attribute suggests the horizontal alignment of the line. Possible values are **left**, **right**, and **center**. The deprecated **WIDTH** attribute specifies the width of the line as a percentage or a number of pixels. If a width is specified, percentages are generally preferred since they adjust to varying window sizes. The **width** property of Cascading Style Sheets provides greater flexibility in suggesting the width of horizontal rules.

The boolean **NOSHADE** attribute suggests that the rule be rendered as a solid line rather than the groove style commonly used. The **SIZE** attribute suggests the height of the line in pixels. These attributes are both deprecated in favor of style sheets.

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HTML 4.0 Reference ~ Elements by Function ~ Elements Alphabetically

WDG

```
<HTML>
   <HEAD>
      <TITLE>My Page</TITLE>
   </HEAD>

   <BODY BGCOLOR=”white” TEXT=”black” LINK=”blue” VLINK=”blue”>
      <CENTER>
         <HR WIDTH=”50%”>
         <P>Check out <A HREF=”index.htm”>my Web site</A> !</P>
         <HR WIDTH=”50%”>
      </CENTER>
   </BODY>
</HTML>
```

Figure 51. Solution to essay question 46.

Appendix E (Continued)

Table 18. Grading Rubric for Essay Question 46

	Objective		
Item (1 point each)	T[a]	Ex1[b]	Ex2[c]
HTML tags around all	3c		
HEAD section first	3b		
TITLE tags around *My Page*	4c		
BODY section next	3b		
BGCOLOR and TEXT attributes in opening BODY tag	4a		4d, 4a
BGCOLOR="white" TEXT="black"	4d		4d, 4a
HRs and *Check out my Web site!* centered	5c		
WIDTH attribute in HR	4b		
WIDTH="50%"	4b		
A tags around *my Web site*	3a		3a, 4a
HREF="index.htm"	3a		
Check out and *!* both outside of A tags	3a	4a	3a, 4a

Note. Blank entries indicate those items for which an expert's judgment with respect to the objective measured agreed with the target objective.

[a]Target objective. [b]Objective selected by first expert. [c]Objective selected by second expert.

47. Write a complete HTML document that includes the following elements. See Figure 52 for a screen capture of how your code should be rendered by a particular browser. (3 points) Ret

- “Home of the USF Bulls” appears in the title bar.
- The background color is green, the text color is gold, and the visited and unvisited link colors are white. (If necessary, refer to the reference material on BODY provided on page 171.)
- The phrase “Welcome to the USF Bulls’ Web Page” is a level 1 heading and is flush against the right side of the browser window. (If necessary, refer to the reference material on H1 provided on page 176.)
- The page contains the sentence “Check out the highlights from the latest game.”, where the word “highlights” is a link that, when clicked, opens the file “hLights.htm”.

Figure 52. HTML code rendered by Internet Explorer (retention test).

Appendix E (Continued)

H1 - Level-one Heading - Microsoft Internet Explorer

H1 - Level-one Heading

Syntax	<H1>...</H1>
Attribute Specifications	▪ ALIGN=[left | center | right | justify] (horizontal alignment) ▪ common attributes
Contents	Inline elements
Contained in	APPLET, BLOCKQUOTE, BODY, BUTTON, CENTER, DEL, DD, DIV, FIELDSET, FORM, IFRAME, INS, LI, MAP, NOFRAMES, NOSCRIPT, OBJECT, TD, TH

The **H1** element defines a *level-one heading*. A document generally should have exactly one **H1** element to mark the most important heading.

The deprecated **ALIGN** attribute suggests the horizontal alignment for the heading on visual browsers. Possible values are **left**, **right**, **center**, and **justify**. Style sheets provide greater flexibility in suggesting alignment.

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HTML 4.0 Reference ~ Elements by Function ~
Elements Alphabetically

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Appendix E (Continued)

```
<HTML>
   <HEAD>
      <TITLE>Home of the USF Bulls</TITLE>
   </HEAD>

   <BODY BGCOLOR=”green” TEXT=”gold” LINK=”white” VLINK=”white”>
      <H1 ALIGN=”right”>Welcome to the USF Bulls’ Web Page</H1>

      <CENTER>
         <P>Check out the <A HREF=”hLights.htm”>highlights</A>
               from the latest game.
         </P>
      </CENTER>
   </BODY>
</HTML>
```

Figure 53. Solution to essay question 47.

Appendix E (Continued)

Table 19. Grading Rubric for Essay Question 47

Item ($\frac{1}{12}$ point each)	Objective		
	T[a]	Ex1[b]	Ex2[c]
HTML tags around all	3c		
HEAD section first	3b		
TITLE tags around *Home of the USF Bulls*	4c		
BODY section next	3b		
BGCOLOR and TEXT attributes in opening BODY tag	4a		4d, 4a
BGCOLOR="green" TEXT="gold"	4d		4d, 4a
Check out the highlights from the latest game. centered	5c		
ALIGN attribute in opening H1 tag	4b		
ALIGN="right"	4b		
A tags around *highlights*	3a		3a, 4a
HREF="hLights.htm"	3a		
Check out the and *from the latest game.* both outside of A tags	3a	4a	3a, 4a

Note. Blank entries indicate those items for which an expert's judgment with respect to the objective measured agreed with the target objective.

[a]Target objective. [b]Objective selected by first expert. [c]Objective selected by second expert.

Appendix F
HTML Pretest

Social Security Number: __ __ __ - __ __ - __ __ __ __

You will receive **extra credit points** toward EdTech for taking this pretest.

Your answers will provide valuable data for determining the strength of the results of the study associated with the HTML portion of the class. Your responses will not affect your grade in any way. They will be used only for purposes of the study, and will be viewed only by the outside researcher collecting the data. Your individual score will not be reported to any officials associated with this course. Please do your best to answer the questions, but do not be concerned if you do not know any of the answers. You will learn the answers as you complete the HTML assignments.

Thank you for your thoughtful responses to the following questions. Please record your **social security number** and your answers directly on this pretest and on the **scantron** provided.

1. Future changes to your HTML document will be facilitated by doing which of the following?

   (a) using appropriate colors for the text and links

   (b) making the size of images small, so they download faster

   (c) using ample white space and indenting

   (d) using tables to layout elements

2. Given the tag specification <TD> [</TD>], where the brackets indicate that this part is optional, which of the following would be valid ways to use this tag?

   (a) more than one of the following

   (b) <TD>text

   (c) <TD>text</TD>

   (d) </TD>text<TD>

Appendix F (Continued)

3. Which form element(s) can be used to allow only one item in a group to be checked?

   (a) radio buttons

   (b) group buttons

   (c) checkboxes

   (d) groupboxes

4. Which tag allows you to specify either an exact or a relative size for text?

   (a) SMALL

   (b) FONT

   (c) BIG

   (d) REL

5. In general, what will a browser do with a tag it does not recognize?

   (a) report an error

   (b) ignore it

   (c) replace it with a close match

   (d) fix it

6. Which tag is used to create a bulleted list?

   (a) UL

   (b) OL

   (c) LI

   (d) BI

7. If you want to have an image on your Web page with an actual width of 28 pixels download and display faster for the user, what should you do?

   (a) more than one of the following

   (b) specify a width of 14 pixels when including it on your page

   (c) do not specify a width or height for the image

   (d) open the image in an image editor and make it smaller

8. Which table tag makes text appear strongly emphasized (bold in some browsers)?

   (a) more than one of the following

   (b) TR

   (c) TD

   (d) TH

9. What should you set the TARGET attribute of the A tag to, if you want the new page displayed after clicking a link in a frame to wipe out all frames and be displayed in the entire original browser window?

   (a) _blank

   (b) _window

   (c) _top

   (d) _new

10. Please indicate the number of years of experience you have with typesetting and/or document formatting languages such as HTML and LaTeX.

   (a) 0

   (b) less than 1

   (c) 1-2

   (d) 2-5

   (e) over 5

11. Please indicate the number of years of experience you have with authoring environments such as Authorware, IconAuthor, and Quest and/or programming languages such as Ada, BASIC, C, Cobol, Fortran, Java, JavaScript, LISP, Pascal, Visual Basic, Visual C, etc.

    (a) 0

    (b) less than 1

    (c) 1-2

    (d) 2-5

    (e) over 5

Appendix G
HTML Posttest

Name: ______________________ SS#: __ __ __ - __ __ - __ __ __ __

Please circle your answers on the actual exam and mark them on the scantron provided. Also, please fill in your name and social security number on both the exam and the scantron.

1. While not technically correct (according to the HTML 4.0 specification), browsers will generally allow you to do which of the following and still render your page as requested?

   (a) more than one of the following

   (b) <B><I>text</B></I>
   (should be: <B><I>text</I></B>)

   (c) <BODY TEXT="gray"> text </BODY TEXT="gray">
   (should be: <BODY TEXT="gray"> text </BODY>)

   (d) <HR>text</HR>
   (should be: <HR>text)

2. What should you set the TARGET attribute of the A tag to, if you want a new browser window to be opened when the corresponding link is clicked?

   (a) _blank

   (b) _window

   (c) _top

   (d) _new

3. Which tag causes the browser to display a bullet or number (depending on the kind of list in which it is used)?

   (a) OL

   (b) UL

   (c) LI

   (d) TYPE

4. When writing HTML code, using ample white space (spaces, tabs, blank lines) and lining up end tags under start tags allows ____________ .

   (a) more than one of the following

   (b) a browser to process the code more quickly

   (c) a browser to determine if any tags are missing more easily

   (d) a human to make future changes to the code more easily

5. What is the minimum number of opening LI tags required for a list with 3 bullets?

   (a) 1

   (b) 2

   (c) 3

   (d) 4

6. In order to view changes to an HTML document that is currently displayed by the browser, what must you do? Note that the changes were made after the document was opened in the browser.

   (a) You need do nothing, since the browser display will automatically be updated.

   (b) You need to click the *Back* button on the browser.

   (c) You need to click the *Reload* or *Refresh* button on the browser.

   (d) You need to click the *Forward* button on the browser.

7. Which table tag designates a cell in a row?

   (a) more than one of the following

   (b) TR

   (c) TD

   (d) TH

Appendix G (Continued)

8. Which tag is used to mark text as bold?
   (a) B
   (b) D
   (c) BOLD
   (d) DARK
9. Which tag must all browsers render the same?
   (a) STRONG
   (b) EM
   (c) I
   (d) KBD
10. Which table attribute increases the distance BETWEEN cells?
    (a) WIDTH
    (b) BORDER
    (c) CELLPADDING
    (d) CELLSPACING
11. You may use a Web browser to view which of the following?
    (a) all of the following
    (b) online documents saved on a Web server
    (c) offline documents saved on the local machine
    (d) the source of an HTML document

Appendix G (Continued)

12. Different browsers may render which of the following tags as they see fit?

    (a) I

    (b) TT

    (c) EM

    (d) U

13. Which cell alignments are possible in a table?

    (a) more than one of the following

    (b) vertical

    (c) horizontal

    (d) angled

14. Which attribute of the image tag must be set to 0 to disable the box that appears around a clickable image?

    (a) BORDER

    (b) BOX

    (c) SUBJECT

    (d) ALT

15. It is possible to supply alternative content in your frameset for browsers that are unable to ____________ .

    (a) view images

    (b) load frames

    (c) frame images

    (d) view targets

16. Given the tag specification <I></I>, which of the following would be valid ways to use this tag?
    - (a) more than one of the following
    - (b) <I>text
    - (c) <I>text</I>
    - (d) </I>text<I>
17. Which heading level tag will be displayed most prominently?
    - (a) HR
    - (b) H0
    - (c) H2
    - (d) H6
18. Which attribute is used to change the look of a bullet?
    - (a) VALUE
    - (b) TYPE
    - (c) LOOK
    - (d) NAME
19. Which attribute of the image tag is used to specify what nongraphical browsers will see and what graphical browsers see while waiting for the image to download?
    - (a) BORDER
    - (b) BOX
    - (c) SUBJECT
    - (d) ALT

20. Given the start tag <FONT SIZE="+1">, what should the end tag look like?

    (a) more than one of the following

    (b) </FONT SIZE="+1">

    (c) </FONT SIZE="-1">

    (d) </FONT>

21. In order for form elements of type radio to work together, they must all have the same value for which attribute?

    (a) VALUE

    (b) NAME

    (c) SYNC

    (d) CHECKED

22. In the image coordinate system, where is the origin (0,0) for the image?

    (a) center

    (b) top, left

    (c) top, right

    (d) bottom, left

23. It is possible to change the ____________ a submit button.

    (a) range of

    (b) message displayed on

    (c) source referenced on

    (d) type of

24. What attribute of the FRAME tag must be set in order to use it as a target for A tags?

    (a) TARGET

    (b) NAME

    (c) SRC

    (d) HREF

25. Which image attribute do you change to bring in a different image?

    (a) IMG

    (b) ALT

    (c) NEW

    (d) SRC

26. What is the minimum number of opening UL tags required for a list with 3 bullets?

    (a) 1

    (b) 2

    (c) 3

    (d) 4

27. What does the reset form element do?

    (a) reloads the page

    (b) sets all form elements to blank states

    (c) reloads the frame currently selected

    (d) sets all form elements to original states

Appendix G (Continued)

28. Which of the following attributes is NOT defined for a table cell?

    (a) NOWRAP

    (b) COLSPAN

    (c) WRAPSPAN

    (d) ROWSPAN

29. Which table tag designates a row?

    (a) more than one of the following

    (b) TR

    (c) TD

    (d) TH

30. On a page that includes an image with text following it, the text that follows may or may not appear to download at a different rate of speed when the width and height of the image are specified. Will that rate be faster, slower, the same, or depend on the size of the image?

    (a) faster

    (b) slower

    (c) same

    (d) depends on image size

31. Which attribute is used with form INPUT of type text to limit the amount of data that the user is allowed to type into the textfield?

    (a) LIMIT

    (b) TYPE

    (c) SIZE

    (d) MAXLENGTH

32. How would you specify in a FRAMESET tag that you would like two rows with the top row containing a frame of height 50 pixels?

    (a) ROWS="*,50%"

    (b) ROWS="50%,*"

    (c) ROWS="50,*"

    (d) ROWS="*,50"

33. It is advisable to use a template file for the following reason(s).

    (a) all of the following

    (b) User's will not be able to view your index page without one.

    (c) It will reduce the amount of time the user must wait to view HTML documents at your Web site.

    (d) It will speed the production of future HTML documents for your Web site.

34. Which tag is used to create a numbered list?

    (a) LI

    (b) LN

    (c) NL

    (d) OL

35. When information supplied by the user via a form element in an HTML document is to be sent to and processed by a cgi-script, it is necessary to set which attribute of the element appropriately, so that the script can access the information?

    (a) SIZE

    (b) NAME

    (c) SRC

    (d) ACCEPT

Appendix G (Continued)

36. FRAMESET tags can be ___________ .

    (a) overlayed

    (b) nested

    (c) shifted

    (d) split

37. Write a complete HTML document that includes the following elements. See the image below for a screen capture of how your code should be rendered by a particular browser. **Please write your answer on the last page of the exam.** (12 points)

    - "My Page" appears in the title bar.
    - The background color is white, the text color is black, and the visited and unvisited link colors are blue.
    - Two centered horizontal rules span 50% of the screen. (If necessary, refer to the reference material on BODY and HR provided on pages 194 and 195.)
    - The page contains the sentence "Check out my Web site!", where the phrase "my Web site" is a link that, when clicked, opens the file "index.htm".

HTML code rendered by Internet Explorer.

Please write your answer on the last page of the exam (page 196).

Appendix G (Continued)

BODY - DOCUMENT BODY - MICROSOFT INTERNET EXPLORER

BODY - Document Body

Syntax	<BODY>...</BODY>
Attribute Specifications	▪ BACKGROUND=*URI* (background image for document) ▪ BGCOLOR=*Color* (background color for document) ▪ TEXT=*Color* (text color for document) ▪ LINK=*Color* (link color for document) ▪ VLINK=*Color* (visited link color for document) ▪ ALINK=*Color* (active link color for document) ▪ ONLOAD=*Script* (document has been loaded) ▪ ONUNLOAD=*Script* (document has been exited) ▪ common attributes
Contents	▪ In HTML 4.0 Strict: one or more block-level elements or SCRIPT, INS, DEL ▪ In HTML 4.0 Transitional: inline elements, block-level elements, INS, DEL
Contained in	▪ In HTML 4.0 Strict or Transitional: HTML ▪ In HTML 4.0 Frameset: NOFRAMES

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BODY takes a number of attributes for specifying the background and colors of the document on visual browsers. These attributes are deprecated in HTML 4.0 in favor of style sheets, which provide greater flexibility in suggesting the presentation of a document. **BGCOLOR** suggests a background color, **TEXT** suggests a text color, **LINK** suggests a link color, **VLINK** suggests a visited link color, and **ALINK** suggests an active link color (when the link is selected). If one of these attributes is given, then all of them should be included to ensure that the user's chosen colors do not interfere with those suggested in the <**BODY**> tag. Authors should not rely on the specified colors being used since browsers allow these colors to be overridden by the user.

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HTML 4.0 Reference ~ Elements by Function ~ Elements Alphabetically

Appendix G (Continued)

HR - Horizontal Rule - Microsoft Internet Explorer

HR - Horizontal Rule

Syntax <HR>

Attribute Specifications

- ALIGN=[left | center | right] (horizontal alignment)
- NOSHADE (solid line)
- SIZE=*Pixels* (line height)
- WIDTH=*Length* (line width)
- core attributes
- common events

Contents Empty

Contained in APPLET, BLOCKQUOTE, BODY, BUTTON, CENTER, DD, DEL, DIV, FIELDSET, FORM, IFRAME, INS, LI, MAP, NOFRAMES, NOSCRIPT, OBJECT, TD, TH

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HR's deprecated **ALIGN** attribute suggests the horizontal alignment of the line. Possible values are **left**, **right**, and **center**. The deprecated **WIDTH** attribute specifies the width of the line as a percentage or a number of pixels. If a width is specified, percentages are generally preferred since they adjust to varying window sizes. The **width** property of Cascading Style Sheets provides greater flexibility in suggesting the width of horizontal rules.

The boolean **NOSHADE** attribute suggests that the rule be rendered as a solid line rather than the groove style commonly used. The **SIZE** attribute suggests the height of the line in pixels. These attributes are both deprecated in favor of style sheets.

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HTML 4.0 Reference ~ Elements by Function ~ Elements Alphabetically

Appendix G (Continued)

Name: ______________________ SS#: __ __ __ - __ __ - __ __ __ __

Write your answer to question 37 here. Also, please fill in your name and social security on this sheet as well.

office use only
H:
H:
T:
B:
IN:
CC:
C:
IN:
P:
A:
H:
O:

Appendix H
HTML Retention Test

Name: ______________________ SS#: __ __ __ - __ __ - __ __ __ __

Please circle your answers on the actual exam and mark them on the scantron provided. Also, please fill in your name and social security number on both the exam and the scantron.

1. Future changes to your HTML document will be facilitated by doing which of the following?
   (a) using appropriate colors for the text and links
   (b) making the size of images small, so they download faster
   (c) using ample white space and indenting
   (d) using tables to layout elements

2. Which form element(s) can be used to allow only one item in a group to be checked?
   (a) radio buttons
   (b) group buttons
   (c) checkboxes
   (d) groupboxes

3. What should you set the TARGET attribute of the A tag to, if you want the new page displayed after clicking a link in a frame to wipe out all frames and be displayed in the entire original browser window?
   (a) _blank
   (b) _window
   (c) _top
   (d) _new

Appendix H (Continued)

4. If you want to have an image on your Web page with an actual width of 28 pixels download and display faster for the user, what should you do?

   (a) more than one of the following

   (b) specify a width of 14 pixels when including it on your page

   (c) do not specify a width or height for the image

   (d) open the image in an image editor and make it smaller

5. Which tag is used to create a bulleted list?

   (a) UL

   (b) OL

   (c) LI

   (d) BI

6. In general, what will a browser do with a tag it does not recognize?

   (a) report an error

   (b) ignore it

   (c) replace it with a close match

   (d) fix it

7. Which table tag makes text appear strongly emphasized (bold in some browsers)?

   (a) more than one of the following

   (b) TR

   (c) TD

   (d) TH

8. Given the tag specification <TD> [</TD>], where the brackets indicate that this part is optional, which of the following would be valid ways to use this tag?

   (a) more than one of the following

   (b) <TD>text

   (c) <TD>text</TD>

   (d) </TD>text<TD>

9. Which tag allows you to specify either an exact or a relative size for text?

   (a) SMALL

   (b) FONT

   (c) BIG

   (d) REL

Appendix H (Continued)

10. Write a complete HTML document that includes the following elements. See the image below for a screen capture of how your code should be rendered by a particular browser.

    - “Home of the USF Bulls” appears in the title bar.
    - The background color is green, the text color is gold, and the visited and unvisited link colors are white. (If necessary, refer to the reference material on BODY provided on page 201.)
    - The phrase “Welcome to the USF Bulls’ Web Page” is a level 1 heading and is flush against the right side of the browser window. (If necessary, refer to the reference material on H1 provided on page 202.)
    - The page contains the sentence “Check out the highlights from the latest game.”, where the word “highlights” is a link that, when clicked, opens the file “hLights.htm”.

HTML code rendered by Internet Explorer.

Please write your answer on the last page of the exam (page 203).

BODY - Document Body - Microsoft Internet Explorer

BODY - Document Body

Syntax <BODY>...</BODY>

Attribute Specifications

- BACKGROUND=*URI* (background image for document)
- BGCOLOR=*Color* (background color for document)
- TEXT=*Color* (text color for document)
- LINK=*Color* (link color for document)
- VLINK=*Color* (visited link color for document)
- ALINK=*Color* (active link color for document)
- ONLOAD=*Script* (document has been loaded)
- ONUNLOAD=*Script* (document has been exited)
- common attributes

Contents

- In HTML 4.0 Strict: one or more block-level elements or SCRIPT, INS, DEL
- In HTML 4.0 Transitional: inline elements, block-level elements, INS, DEL

Contained in

- In HTML 4.0 Strict or Transitional: HTML
- In HTML 4.0 Frameset: NOFRAMES

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.

BODY takes a number of attributes for specifying the background and colors of the document on visual browsers. These attributes are deprecated in HTML 4.0 in favor of style sheets, which provide greater flexibility in suggesting the presentation of a document. **BGCOLOR** suggests a background color, **TEXT** suggests a text color, **LINK** suggests a link color, **VLINK** suggests a visited link color, and **ALINK** suggests an active link color (when the link is selected). If one of these attributes is given, then all of them should be included to ensure that the user's chosen colors do not interfere with those suggested in the <**BODY**> tag. Authors should not rely on the specified colors being used since browsers allow these colors to be overridden by the user.

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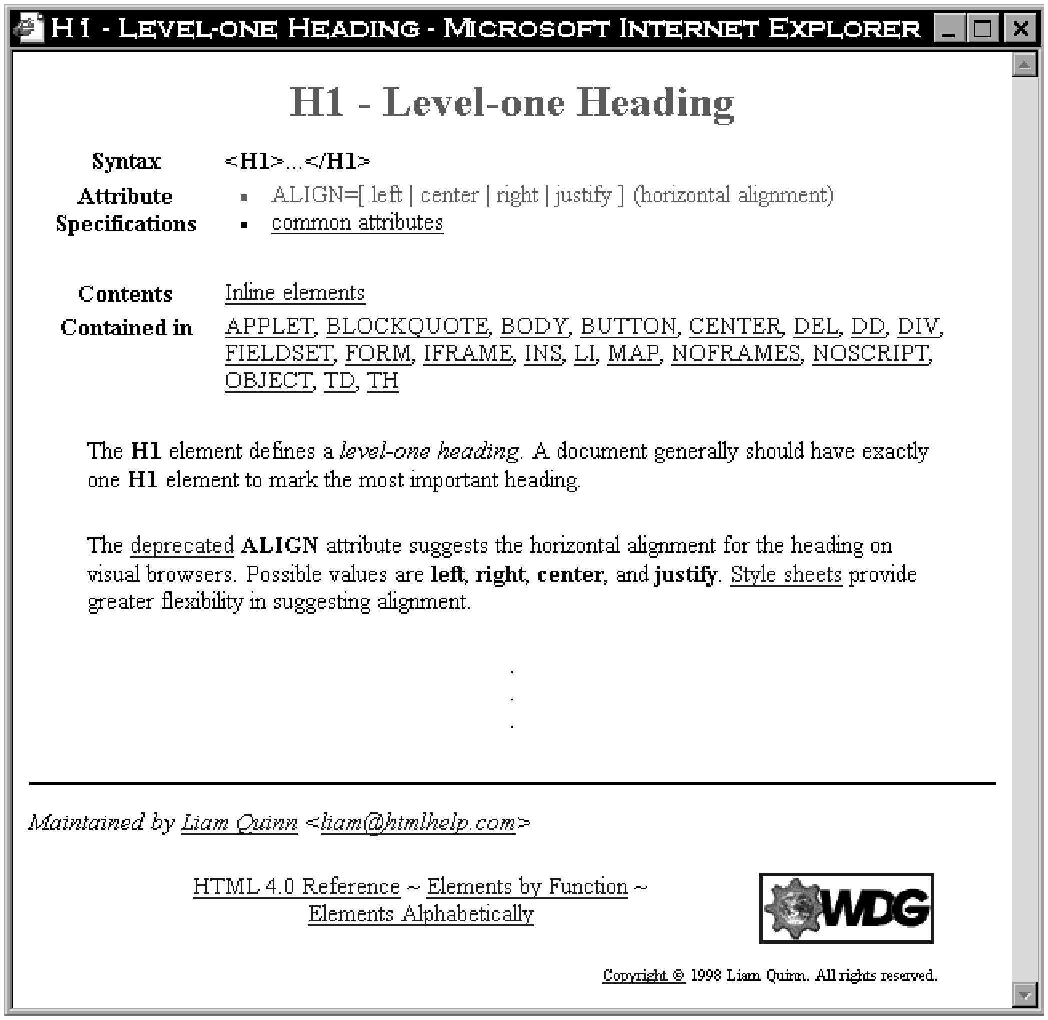
Maintained by Liam Quinn <liam@htmlhelp.com>

WDG HTML 4.0 Reference ~ Elements by Function ~ Elements Alphabetically

Appendix H (Continued)



H1 - Level-one Heading - Microsoft Internet Explorer

H1 - Level-one Heading

Syntax	<H1>...</H1>
Attribute Specifications	▪ ALIGN=[left | center | right | justify] (horizontal alignment) ▪ common attributes
Contents	Inline elements
Contained in	APPLET, BLOCKQUOTE, BODY, BUTTON, CENTER, DEL, DD, DIV, FIELDSET, FORM, IFRAME, INS, LI, MAP, NOFRAMES, NOSCRIPT, OBJECT, TD, TH

The **H1** element defines a *level-one heading*. A document generally should have exactly one **H1** element to mark the most important heading.

The deprecated **ALIGN** attribute suggests the horizontal alignment for the heading on visual browsers. Possible values are **left**, **right**, **center**, and **justify**. Style sheets provide greater flexibility in suggesting alignment.

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HTML 4.0 Reference ~ Elements by Function ~ Elements Alphabetically

WDG

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Appendix H (Continued)

Name: ______________________ SS#: __ __ __ - __ __ - __ __ __ __

Write your answer to question 10 here. Also, please fill in your name and social security number on this sheet as well.

office use only
H:
H:
T:
B:
IN:
CC:
C:
IN:
P:
A:
H:
O:

Appendix I
Letter to HTML Expert

Dear HTML Expert,

Thank you for taking the time to evaluate the content validity of the measures for this study. Your time and insight are greatly appreciated.

Prior Experience

The students will be asked to answer the question in Figure 54 before any treatments are administered. Please respond to the questions that follow.

Do you have computer programming or typesetting experience with any of the languages listed below or any languages not listed (please list)? If yes, please indicate the approximate number of years experience you have with each one.

___ yrs of Ada	___ yrs of HTML	___ yrs of Pascal
___ yrs of BASIC	___ yrs of Java	___ yrs of Visual Basic
___ yrs of C	___ yrs of JavaScript	___ yrs of Visual C
___ yrs of Cobol	___ yrs of LaTeX	___ yrs of __________
___ yrs of Fortran	___ yrs of LISP	___ yrs of __________

Figure 54. Self-report experience item on pretest.

- Do you agree that experience with any of the languages listed would likely give a student enough of an advantage to merit concern? (Please cross out any you think are not pertinent.)

- Are there any other prior experiences you feel would give a student enough of an advantage to merit concern that should be ascertained before treatment?

Appendix I (Continued)

Objectives

You will find the implicit objectives of the courseware stated explicitly in the first attachment. Approximate relative weightings appear next to each and reflect the percentage of questions on the pretest, posttest, and retention tests that are intended to measure each item. Based on your knowledge of what is important when creating HTML documents using a plain text editor (as opposed to a WYSIWYG editor), please respond to the following questions.

- Do you feel that the most important objectives have been included?

- Please list any important objectives you feel have been left out.

- Please list any included objectives you feel really are not important.

- Do you agree with the relative weighting given for the objectives?

Appendix I (Continued)

- If you do not agree with the relative weighting of the objectives, please indicate an alternative weighting, using percentages. Please cross out any objectives you feel are not important and add in any you feel should be present, but are not.

Objective	Current	Suggested
Browser Basics	4%	
Development, Design, and Style	6%	
Document Structure	13%	
Tags and Attributes	15%	
Text Style	10%	
Lists	10%	
Images	10%	
Tables	10%	
Frames	10%	
Forms	10%	

Test Items

You will find the actual test items in the second attachment. These are all of the items included on all of the achievement measures. Next to each multiple choice item a box is provided for your convenience in rating the clarity and difficulty of the item as well as indicating which objective you feel is tested by the item. Please indicate whether or not you feel the item should be omitted or reworded. You may make changes directly to the item and/or list any other comments you may have to the right of the item.

Please evaluate the two essay questions in like manner, with one exception. The solution code and grading rubrics for the questions are provided. The grading rubric breaks the solution into subitems. Please indicate the objective you feel is measured by each subitem in the appropriate column of the provided table.

While each item is intended to measure only one objective, you may at times, feel that more than one applies. In that case, please list all that seem pertinent,

Appendix I (Continued)

with the most pertinent one listed first. Also, it may be helpful to know, especially in deciding if a question is too difficult, that the measures will be administered to college level freshman who hope to become teachers, many of whom have just obtained their first computer.

I realize that your time is valuable and appreciate your evaluation of these measures. Thank you so much for your feedback. It will be put to good use.

Sincerely,

Tina L. Majchrzak

Appendix J
Expert Evaluation Form for Achievement Measures

Key to Response Boxes

Objective	Fill in the objective measured by the item (e.g. 5b). Each item was written to measure a single objective. However, if more than one objective seems to apply for a given item, please list all that seem appropriate, with the most appropriate one listed first. Determining whether or not 4b applies can be difficult without extensive knowledge of the courseware, so keep in mind that whenever a question refers to an attribute and/or tag *not* formally discussed in the courseware, the question includes reference material on the tag and/or attribute.
Clear	Circle Y if the question is clearly written. Otherwise, circle N, and please suggest alternative wording.
Too Difficult	Circle Y if you feel this item may be too difficult. Otherwise, circle N. Recall that, for the most part, the students are novice computer users.
Remove	Circle Y if you feel this item should not be used. Otherwise, circle N.
Reword	Circle Y if you feel this item should be written differently, and please suggest alternative wording. Otherwise, circle N.
Comments	Please make any notes or further suggestions regarding the item here.

Appendix J (Continued)

1. While not technically correct (according to the HTML 4.0 specification), browsers will generally allow you to do which of the following and still render your page as requested?

   (a) more than one of the following

   (b) <B><I>text</B></I>
   (should be: <B><I>text</I></B>)

   (c) <BODY TEXT="gray"> text </BODY TEXT="gray">
   (should be: <BODY TEXT="gray"> text </BODY>)

   (d) <HR>text</HR>
   (should be: <HR>text)

Objective	
Clear	Y N
Too Difficult	Y N
Remove	Y N
Reword	Y N

Comments:

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.
.

29. It is possible to change the ____________ a submit button.

   (a) range of

   (b) message displayed on

   (c) source referenced on

   (d) type of

Objective	
Clear	Y N
Too Difficult	Y N
Remove	Y N
Reword	Y N

Comments:

30. What attribute of the FRAME tag must be set in order to use it as a target for A tags?

 (a) TARGET

 (b) NAME

 (c) SRC

 (d) HREF

Objective		
Clear	Y	N
Too Difficult	Y	N
Remove	Y	N
Reword	Y	N

Comments:

.
.
.

35. If you want to have an image on your Web page with an actual width of 28 pixels download and display faster for the user, what should you do?

 (a) more than one of the following

 (b) specify a width of 14 pixels when including it on your page

 (c) do not specify a width or height for the image

 (d) open the image in an image editor and make it smaller

Objective		
Clear	Y	N
Too Difficult	Y	N
Remove	Y	N
Reword	Y	N

Comments:

.
.
.

43. What should you set the TARGET attribute of the A tag to, if you want the new page displayed after clicking a link in a frame to wipe out all frames and be displayed in the entire original browser window?

    (a) _blank

    (b) _window

    (c) _top

    (d) _new

Objective	
Clear	Y N
Too Difficult	Y N
Remove	Y N
Reword	Y N

Comments:

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.
.

46. Write a complete HTML document that includes the following elements. See the image below for a screen capture of how your code should be rendered by a particular browser. (12 points)

    - "My Page" appears in the title bar.
    - The background color is white, the text color is black, and the visited and unvisited link colors are blue.
    - Two centered horizontal rules span 50% of the screen. (If necessary, refer to the reference material on HR provided on page 213.)
    - The page contains the sentence "Check out my Web site!", where the phrase "my Web site" is a link that, when clicked, opens the file "index.htm".

Objective	*fill in boxes on page 214*
Clear	Y N
Too Difficult	Y N
Remove	Y N
Reword	Y N

Comments:

HTML code rendered by Internet Explorer.

Appendix J (Continued)

HR - Horizontal Rule - Microsoft Internet Explorer

HR - Horizontal Rule

Syntax <HR>

Attribute Specifications

- ALIGN=[left | center | right] (horizontal alignment)
- NOSHADE (solid line)
- SIZE=*Pixels* (line height)
- WIDTH=*Length* (line width)
- core attributes
- common events

Contents Empty

Contained in APPLET, BLOCKQUOTE, BODY, BUTTON, CENTER, DD, DEL, DIV, FIELDSET, FORM, IFRAME, INS, LI, MAP, NOFRAMES, NOSCRIPT, OBJECT, TD, TH

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HR's deprecated **ALIGN** attribute suggests the horizontal alignment of the line. Possible values are **left**, **right**, and **center**. The deprecated **WIDTH** attribute specifies the width of the line as a percentage or a number of pixels. If a width is specified, percentages are generally preferred since they adjust to varying window sizes. The **width** property of Cascading Style Sheets provides greater flexibility in suggesting the width of horizontal rules.

The boolean **NOSHADE** attribute suggests that the rule be rendered as a solid line rather than the groove style commonly used. The **SIZE** attribute suggests the height of the line in pixels. These attributes are both deprecated in favor of style sheets.

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Maintained by Liam Quinn <liam@htmlhelp.com>

HTML 4.0 Reference ~ Elements by Function ~ Elements Alphabetically

WDG

Appendix J (Continued)

Solution to essay question 46

```
<HTML>
   <HEAD>
      <TITLE>My Page</TITLE>
   </HEAD>

   <BODY BGCOLOR=”white” TEXT=”black” LINK=”blue” VLINK=”blue”>
      <CENTER>
         <HR WIDTH=”50%”>
         <P>Check out <A HREF=”index.htm”>my Web site</A> !</P>
         <HR WIDTH=”50%”>
      </CENTER>
   </BODY>
</HTML>
```

Table 20. Form Used to Analyze Grading Rubric for Essay Question 46

Item	Objective
HTML tags around all	
HEAD section first	
TITLE tags around *My Page*	
BODY section next	
BGCOLOR and TEXT attributes in opening BODY tag	
BGCOLOR=“white” TEXT=“black”	
HRs and *Check out my Web site!* centered	
WIDTH attribute in HR	
WIDTH=“50%”	
A tags around *my Web site*	
HREF=“index.htm”	
Check out and *!* both outside of A tags	

47. Write a complete HTML document that includes the following elements. See the image below for a screen capture of how your code should be rendered by a particular browser. (3 points)

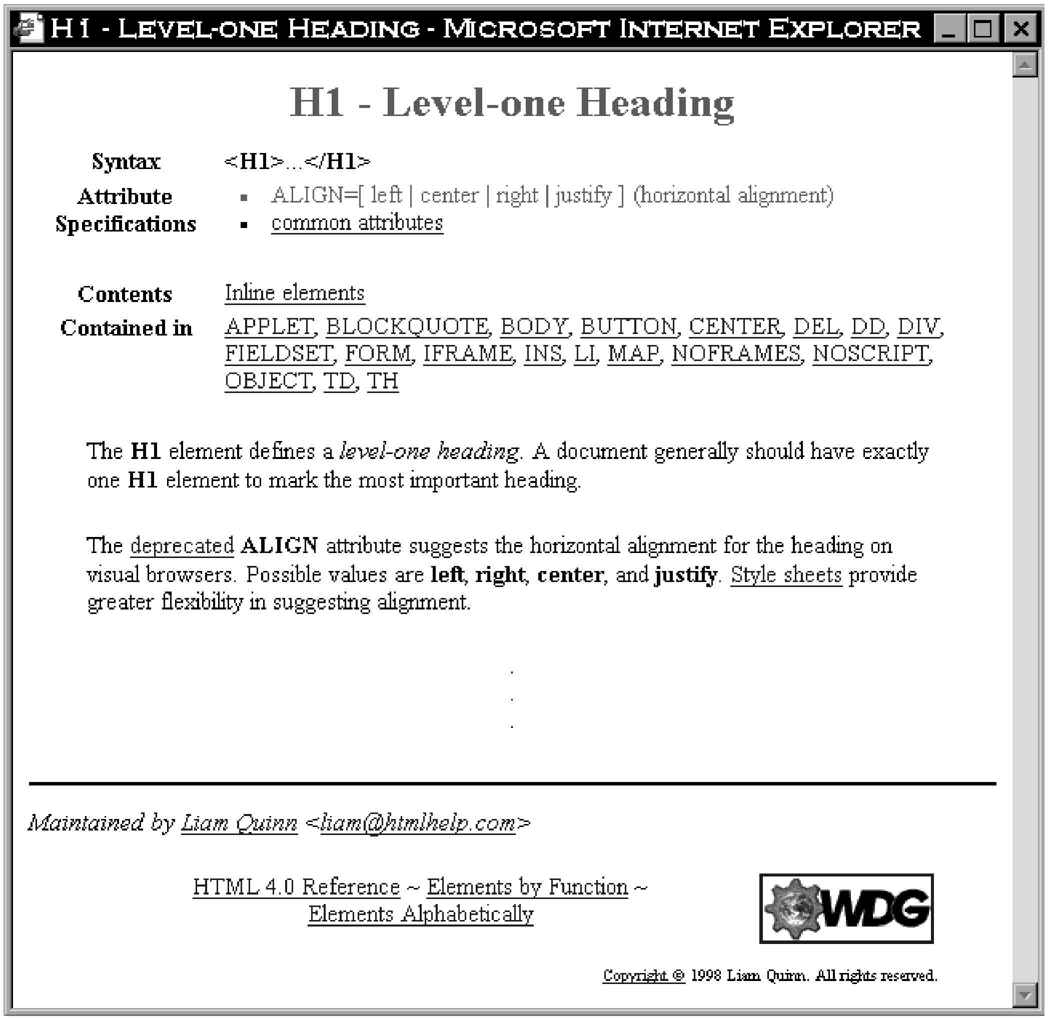
    - “Home of the USF Bulls” appears in the title bar.
    - The background color is green, the text color is gold, and the visited and unvisited link colors are white.
    - The phrase “Welcome to the USF Bulls’ Web Page” is a level 1 heading and is flush against the right side of the browser window. (If necessary, refer to the reference material on H1 provided on page 216.)
    - The page contains the sentence “Check out the highlights from the latest game.”, where the word “highlights” is a link that, when clicked, opens the file “hLights.htm”.

Objective	*fill in boxes on page 217*
Clear	Y N
Too Difficult	Y N
Remove	Y N
Reword	Y N

Comments:

HTML code rendered by Internet Explorer.

Appendix J (Continued)



H1 - Level-one Heading - Microsoft Internet Explorer

H1 - Level-one Heading

Syntax	<**H1**>...</**H1**>
Attribute Specifications	▪ ALIGN=[left | center | right | justify] (horizontal alignment) ▪ common attributes
Contents	Inline elements
Contained in	APPLET, BLOCKQUOTE, BODY, BUTTON, CENTER, DEL, DD, DIV, FIELDSET, FORM, IFRAME, INS, LI, MAP, NOFRAMES, NOSCRIPT, OBJECT, TD, TH

The **H1** element defines a *level-one heading*. A document generally should have exactly one **H1** element to mark the most important heading.

The deprecated **ALIGN** attribute suggests the horizontal alignment for the heading on visual browsers. Possible values are **left**, **right**, **center**, and **justify**. Style sheets provide greater flexibility in suggesting alignment.

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Maintained by Liam Quinn <liam@htmlhelp.com>

HTML 4.0 Reference ~ Elements by Function ~ Elements Alphabetically

WDG

Appendix J (Continued)

Solution to Essay Question 47

```
<HTML>
   <HEAD>
      <TITLE>Home of the USF Bulls</TITLE>
   </HEAD>

   <BODY BGCOLOR=”green” TEXT=”gold” LINK=”white” VLINK=”white”>
      <H1 ALIGN=”right”>Welcome to the USF Bulls’ Web Page</H1>

      <CENTER>
         <P>Check out the <A HREF=”hLights.htm”>highlights</A>
               from the latest game.
         </P>
      </CENTER>
   </BODY>
</HTML>
```

Appendix J (Continued)

Table 21. Form Used to Analyze Grading Rubric for Essay Question 47

Item	Objective
HTML tags around all	
HEAD section first	
TITLE tags around *Home of the USF Bulls*	
BODY section next	
BGCOLOR and TEXT attributes in opening BODY tag	
BGCOLOR="green" TEXT="gold"	
Check out the highlights from the latest game. centered	
ALIGN attribute in opening H1 tag	
ALIGN="right"	
A tags around *highlights*	
HREF="hLights.htm"	
Check out the and *from the latest game.* both outside of A tags	

Appendix K
Self-Report Measure of Pacing Preference

Name: ______________________ SS#: __ __ __ - __ __ - __ __ __ __

You will receive **extra credit points** toward EdTech for taking this survey.

The information you provide is of paramount importance in determining the merits of the instructional format of the HTML portion of this course. It will aid in making future improvements to it and will shed light on the instructional format most preferred by students in general.

Your responses will be considered separately from your course performance by an outside researcher, who will only know you by an independent number assigned to you for the study. Your name and social security number will be converted to this study number. Specifying this information here is necessary to make sure that responses are placed into the correct groups for data analysis. Your name and social security number will be used for this purpose only, and then will be deleted from your responses. Your responses will be grouped with those of other students. Reports of the findings will be in terms of groups rather than in terms of individuals. Your individual responses will not be reported to any officials associated with this course or to any other individuals, so you may consider your responses to be anonymous.

Thank you for your thoughtful consideration of the following questions. Please record your **name**, **social security number** and answers directly on this survey and on the **scantron** provided.

1. Given a choice in a future class between live lectures and lectures prerecorded on CD-ROM or video cassette, which would you prefer?

Really Prefer Live	Somewhat Prefer Live	No Preference	Somewhat Prefer Prerecorded	Really Prefer Prerecorded
1	2	3	4	5

2. Given a choice in a future class to learn in either a very large group with 100 or more students, a large group with 30-50 students, a small, *self-made* group with 2-5 students, or alone, which would you prefer?

Prefer 100+	Prefer 30-50	No Preference	Prefer 2-5	Prefer Alone
1	2	3	4	5

3. Given a choice in a future class to learn at flexible, self-determined times or at externally set, structured times each week, which would you prefer?

Really Prefer Flexible	Somewhat Prefer Flexible	No Preference	Somewhat Prefer Structured	Really Prefer Structured
1	2	3	4	5

4. Given a choice in a future class to hear all of the questions and answers of fellow students in person or to have deferred access to select questions and answers maintained in a Frequently Asked Questions (FAQs) archive, which would you prefer?

Really Prefer All, Live	Somewhat Prefer All, Live	No Preference	Somewhat Prefer Select, Archive	Really Prefer Select, Archive
1	2	3	4	5

5. Given a choice in a future class to break a one hour lecture into six 10-minute lectures viewed at your discretion or to view the entire lecture all at once, which would you prefer?

Really Prefer Six 10-minute	Somewhat Prefer Six 10-minute	No Preference	Somewhat Prefer One 1-hour	Really Prefer One 1-hour
1	2	3	4	5

6. Given a choice in a future class to complete assignments at a pace set by yourself or at a pace set by the teacher, which would you prefer?

Really Prefer Self Set	Somewhat Prefer Self Set	No Preference	Somewhat Prefer Teacher Set	Really Prefer Teacher Set
1	2	3	4	5

7. Given a choice in a future class to use supplied grading rubrics to evaluate your own work frequently at small, intermediate stages or to have a teacher evaluate your work less often at two or three main junctures, which would you prefer?

Really Prefer Self, Frequent	Somewhat Prefer Self, Frequent	No Preference	Somewhat Prefer Teacher, Sparse	Really Prefer Teacher, Sparse
1	2	3	4	5

8. Given a choice between teacher-paced instruction using the lecture method and self-paced instruction delivered via CD-ROM, which instructional format would you prefer?

Really Prefer Teacher-paced	Somewhat Prefer Teacher-paced	No Preference	Somewhat Prefer Self-paced	Really Prefer Self-paced
1	2	3	4	5

Appendix L
Letter to Instructional Paradigms Expert

Dear Expert on Teacher-Paced and Self-Paced Instruction,

Thank you for taking the time to evaluate the content validity of the measures for this study. Your time and insight are greatly appreciated.

Please note that the overall purpose of the measures is to determine if differences exist between the responses of students in three treatment groups. The treatments are focused on deadlines. All groups have the same deadlines. However, for one group, these are merely *recommended*. For another, they are *conditional* with bonus points awarded for early submissions and penalty points deducted for late submissions. For the third, they are *absolute* with no late submissions accepted. Please keep this context in mind during your evaluation.

Aspects of Self-Pacing

The students will be asked to respond to eight self-report items after the treatments have been administered. Each is bipolar in nature, requiring them to express a preference for either self-paced instruction or instructor-paced instruction along a five point scale. The questions cover common features of the learning environment which differentiate these two instructional approaches. They are listed below in no particular order. Please look them over and then respond to the questions that follow.

- Live lecture versus prerecorded lecture
- Learning in a large group versus a small group (possibly of size 1)
- Learning during structured class time each week versus flexible, self-determined times
- Access to all students' questions and answers in person versus online access to select questions and answers
- One 1-hour lecture versus six 10-minute lectures
- Teacher set deadlines versus student set deadlines

Appendix L (Continued)

1. Do you feel that the most important features that distinguish self-paced instruction from instructor-paced instruction have been included?

2. Please list any important features you feel have been left out.

3. Please list any included features you feel really are not important.

Self-Report Items

You will find the actual self-report items attached. Next to each item a box is provided for your convenience in rating the clarity of the item as well as indicating which value (1 or 5) represents the highest preference for self-pacing. Please indicate whether or not you feel the item should be omitted or reworded. You may make changes directly to the item and/or list any other comments you may have to the right of the item.

Procrastination Level

Procrastination level will be measured in terms of the items listed below. It is anticipated that the different treatment conditions, which focus on deadlines, may yield different values for these items. Please consider them and answer the questions that follow.

- average number of requests for deadline extensions per student
- average number of days late on assignments per student

Appendix L (Continued)

1. In the context of recommended versus conditional versus absolute deadlines, do you feel that the most important indicators of student procrastination level have been included?

2. Please list any important indicators you feel have been left out.

3. Please list any included indicators you feel really are not important.

I realize that your time is valuable and appreciate your evaluation of these measures. Thank you so much for your feedback. It will be put to good use.

Sincerely,

Tina L. Majchrzak

Appendix M
Expert Evaluation Form for Pacing Preference Measure

Key to Response Boxes

Self-Paced	Circle 1 if the low end of the scale implies a preference for self-pacing. Circle 5 if the high end of the scale implies a preference for self-pacing.
Clear	Circle Y if the question is clearly written. Otherwise, circle N, and please suggest alternative wording.
Remove	Circle Y if you feel this item should not be used. Otherwise, circle N.
Reword	Circle Y if you feel this item should be written differently, and please suggest alternative wording. Otherwise, circle no.
Comments	Please make any notes or further suggestions regarding the item here.

1. Given a choice in a future class between lectures recorded on CD-ROM and live lectures, which would you prefer?

Prefer CD-ROM		No Preference		Prefer Live
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

2. Given a choice in a future class between lectures recorded on video cassette and live lectures, which would you prefer?

Prefer Video Cassette		No Preference		Prefer Live
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

3. Given a choice in a future class to learn either in a large, nondescript group with 30-50 students or to learn in a small, self-made group with 2-5, which would you prefer?

Prefer Nondescript, 30-50		No Preference		Prefer Self-made, 2-5
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

4. Given a choice in a future class to learn either in a large, nondescript group with 30-50 students or to learn alone, which would you prefer?

Prefer Nondescript, 30-50		No Preference		Prefer Alone
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

5. Given a choice in a future class to learn either in a very large, nondescript group with 100 or more students or to learn in a small, self-made group with 2-5, which would you prefer?

Prefer Nondescript, 100+		No Preference		Prefer Self-made, 2-5
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

6. Given a choice in a future class to learn either in a very large, nondescript group with 100 or more students or to learn alone, which would you prefer?

Prefer Nondescript, 100+		No Preference		Prefer Alone
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

7. Given a choice in a future class to learn at flexible, self-determined times or at externally set, structured times each week, which would you prefer?

Prefer Flexible		No Preference		Prefer Structured
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

8. Given a choice in a future class to hear all of the questions and answers of fellow students in person or to have access to select questions and answers online in a Frequently Asked Questions (FAQs) archive, which would you prefer?

Prefer All, Live		No Preference		Prefer Select, Archive
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

9. Given a choice in a future class to break a one hour lecture into six 10-minute lectures viewed at your discretion or to view the entire lecture all at once, which would you prefer?

Prefer Six 10-minute		No Preference		Prefer One 1-hour
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

Appendix M (Continued)

10. Given a choice in a future class to complete assignments at a pace set by yourself or at a pace set by the instructor, which would you prefer?

Prefer Self Set		No Preference		Prefer Teacher Set
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

11. Given a choice between instructor-paced instruction using the lecture method and self-paced instruction delivered via CD-ROM, which instructional format would you prefer?

Prefer Instructor-paced		No Preference		Prefer Self-paced
1	2	3	4	5

Self-Paced	1	5
Clear	Y	N
Remove	Y	N
Reword	Y	N

Comments:

Appendix N
Expert Evaluation Form for Assignments

Dear HTML Expert,

Thank you for taking the time to evaluate the content validity of the assignments for this study. Your time and insight are greatly appreciated.

The students will be asked to create the Web site described in the courseware completing eight intermediate assignments. Please see provided courseware for details. For the first two assignments, the students are provided with the source HTML, so that they may focus on learning the development cycle of making changes in a text editor and viewing them by refreshing the browser window. They are also provided with all necessary images.

A list of the objectives covered by the assignments appears below followed by the rubrics that will be used to grade the eight assignments. To view the complete form of the rubrics provided to the graders, including graphical directions, please refer to the provided courseware. For each rubric listed below, please indicate which of the ten objectives you feel it measures by placing a value between 1 and 10 in the box next to each one. If you do not feel it measures any of them, put an *N* in the box. If you feel it measures more than one or are not sure which it measures, please list all possibilities with the most appropriate one listed first. Finally, if you feel the rubrics for a given assignment measure any other objectives implicitly that you have not already listed for any of the individual rubrics, please list these objectives in the box at the end of the list of rubrics for the assignment.

I realize that your time is valuable and appreciate your evaluation of these measures. Thank you so much for your feedback. It will be put to good use.

Sincerely,

Tina L. Majchrzak

Appendix N (Continued)

Objectives

1. Browser Basics
    - View a page created and saved on the local machine
    - Recognize the forgiving nature of HTML interpreters
2. Development, Design, and Style
    - Understand the importance of writing readable HTML code
    - Understand the merits of using a template file
    - Be aware of the need to Refresh/Reload a document to see changes
3. Document Structure
    - Include a link to another page
    - Demonstrate knowledge that HTML documents are comprised of two main sections, the HEAD and the BODY
    - Demonstrate knowledge that HTML documents are designated with opening and closing HTML tags that surround the content
4. Tags and Attributes
    - Use tags and attributes correctly
    - Demonstrate an understanding of how tags and attributes work by being able to look up and use tags and attributes not discussed formally in the courseware
    - Set the title displayed in the title bar of the browser
    - Set the background, text, and link colors
5. Text Style
    - Physically markup text (bold, change relative font size)
    - Logically markup text (heading level)
    - Center text

Appendix N (Continued)

6. Lists

   - Include an ordered (numbered) or unordered (bulleted) list
   - Include a number or bullet
   - Set the bullet type for a bulleted list

7. Images

   - Include a simple image
   - Appropriately set the COORDS attribute of the AREA tag in a client-side image map, given coordinates for a clickable region on an image
   - Turn off the border for a clickable image
   - Use the mouseOver and mouseOut attributes of the IMG tag

8. Tables

   - Use the rowspan, nowrap, and valign cell attributes
   - Set the attributes of a table
   - Designate table rows
   - Designate header and data cells

9. Frames

   - Create a frames version of a Web site
   - Set the target of a link to a specific frame, to the top level window, or to a new window
   - Use the NOFRAMES tag to display alternative content

10. Forms

   - Include an INPUT element of TYPE text
   - Include an INPUT element of TYPE radio
   - Include an INPUT element of TYPE reset
   - Include an INPUT element of TYPE submit
   - Call a cgi-script to process the information in specific form elements

Appendix N (Continued)

Assignment Rubrics (annotated with expert's responses)

1. Create Index Page (see Figure 2 for final form of page)

4	*"Student's Name" Home Page* appears on title bar
5,4,3	*"Student's Name"* appears on page
5	Name and hyperlinks are centered
5,4	Name appears in bigger text size
4	Name is dark blue
5,4,3	Currency entity symbol is used between and around textual hyperlinks
3,4	Links are maroon (or black if clicked)
4,3	For hyperlinks, only the word (and not blank space) is underlined
4,3	Background is pale yellow
2,1	Other implicit objectives you feel the assignment covers

2. Create Template File

3,4	*"Student's Name" Home Page* appears on title bar
4,3	BGCOLOR is set to some value
3,4	"Student's Name" appears in copyright notice between HTML comment tags
4,3	TEXT color set to some value
4,3	LINK color set to some value
4,3	VLINK color set to some value
4,3	ALINK color set to some value
2,1	Other implicit objectives you feel the assignment covers

Appendix N (Continued)

3. Create Personal Page

4	: *Personal* appears on title bar
5	*Personal Facts* text centered
5	Paragraph not centered
5,4,3	Navigational hyperlinks centered
5	H1 tag used for title
2,1	Other implicit objectives you feel the assignment covers

4. Create Links Page

3,4	Links all work
6	Open circles for bullets
5,3	Ergonomics defined
5,3	Dangers of radiation discussed
5,3	Effects on eyes discussed
5,3	Methods of protecting eyes discussed
5,3	Effects on arms and hands discussed
5,3	Methods of protecting arms and hands discussed
5,3	Effects on skeleton discussed
5,3	Methods of protecting skeleton discussed
6,5	All paragraphs in bullet indented same amount
1,2,9	Other implicit objectives you feel the assignment covers

5. Add Images

7	Image appears on index page

Appendix N (Continued)

7	For all text in image on index page, mouseOver works
7	For all text in image on index page, mouseOut works
7,4	All image hyperlinks work
7	No rectangle appears around image on index page
3,4	All textual hyperlinks work below image on index page
7,4	All navigational images in place on personal page
3,4,2	For personal page, personal hyperlink disabled
3,4,2	For personal page, all image hyperlinks other than personal work
3,4,2	For personal page, all textual hyperlinks other than personal work
7	For personal page, mouseOver works for all navigational images
7	For personal page, mouseOut works for all navigational images
7	No rectangle appears around image on personal page
1	Other implicit objectives you feel the assignment covers

6. Create Professional Page

8	Table title spans all three columns
8	Table border visible
8	*MS Windows 95* stays on one line regardless of browser window size
8	Specific languages, environments, and tools appear on different lines
7	All navigational images in place on professional page
3,4,2	Professional hyperlink disabled
3,4,2	All image hyperlinks other than professional work
8	Table header cells created with TH tags
1	Other implicit objectives you feel the assignment covers

Appendix N (Continued)

7. Update Links Page

9	splash.htm file loaded initially
9	Hyperlinks in left frame display in right frame when clicked
9	Hyperlinks in right frame display in full browser window
7	All navigational images in place
3,4,2	Links hyperlink disabled
3,4,2	All image hyperlinks other than links work
9,3,4,2	Hyperlinks in bottom navigation frame display in full browser window
9	NOFRAMES tag present in HTML source code
1	Other implicit objectives you feel the assignment covers

8. Update Personal Page

10	User may only type up to three items in each textfield
10	Clicking a radio button turns others off
10	Clicking clear button clears form elements
10	*Clear* text appears on clear button
10	*Process Request* text appears on button
10	Form correctly converts between hexadecimal FF 0 33 and decimal 255 0 51
4,1,2	Other implicit objectives you feel the assignment covers

Appendix O
Self-Report Measure of Study Group Patterns

Name: ______________________ SS#: __ __ __ - __ __ - __ __ __ __

We realize that some of you may have formed study groups for this class, in which you work on assignments and study for exams together. In order to support a consistent experience for the members of these groups and to simplify data analysis for the study associated with the HTML lab, we request that you supply us with some information.

Thank you for your careful consideration of the following questions.

1. Are you a member of a study group for this class? If yes, go to question 3. If no, go to question 2. **Yes** **No**
2. Do you hope to join a study group for this class? If yes, continue. If no, stop and turn in this sheet. **Yes** **No**
3. If you answered yes to either question 1 or 2, please list the first and last names (to the best of your knowledge) of the students in your study group, the group you hope to join, or the group you hope to form.
   ____
   ____
   ____
   ____

Appendix P
Self-Report of Assistance Received

Name: ________________________ SS#: __ __ __ - __ __ - __ __ __ __

We solicit your aid in determining how to analyze the data regarding assignment and test scores for the HTML portion of the class. Depending on which students worked together and what groups they were in, the data must be analyzed with different procedures. It does not matter if you worked alone, with fellow students, and/or received aid from a course official and/or an outside source. This information will merely help us determine how to analyze the data. Again, your name and social security number will be replaced with your study number, and you may consider your answers to be anonymous.

Please fill in your name and social security number above and circle the most appropriate response below or write in an answer. Thank you for your careful consideration of these questions.

1. What percentage of the time did you work on the HTML assignments with fellow classmates?

0	20	40	60	80	100

2. Please list the classmates with whom you worked.

______________________________ ______________________________
______________________________ ______________________________
______________________________ ______________________________
______________________________ ______________________________

3. How often did you receive help completing the HTML assignments from one of the course officials (a course facilitator, a course assistant)?

never	rarely	sometimes	often	always

4. How often did you receive help completing the HTML assignments from an outside source?

never	rarely	sometimes	often	always

Appendix P (Continued)

5. How many of the HTML assignments out of eight would you say you did completely on your own?

0	1	2	3	4	5	6	7	8

6. How many hours **per week** did you spend completing the assignments?

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15+

7. What did you like most about the HTML lessons and assignments?

8. What did you like least about the HTML lessons and assignments?

9. What recommendations would you make for improving the courseware and/or assignments?

Appendix Q
Free Form Responses from Students

On the day the posttest was administered, the students were asked “What did you like most about the HTML lessons and assignments?” Their actual responses and the identified response categories appear below.

1. Nothing
    - nothing
    - (blank)

2. Pride in own accomplishments
    - pride in completing assignments
    - feeling like a professional
    - enhanced computer skills
    - outcome of hard work

3. Relevant, interesting material and assignments
    - learning HTML language
    - learning how to make Web pages
    - challenging/stimulating material
    - relevant material
    - interesting material
    - first basic step-by-step assignments (2-4)
    - final product
    - learning about browsers
    - graphics and colors
    - making swappable images
    - making frames
    - learning terminology associated with Web pages

4. Content on demand
    - could work at home
    - self-paced access to content
    - fast-paced
    - CD-ROM format (versus lecture)
    - reference tool for the future

- ability to review material over and over
- could skip parts I already knew

5. Convenient submission process
    - ability to submit work via e-mail
    - immediate confirmation of assignment submission
    - due at midnight

6. Exposure to different instructional paradigm
    - exposure to a different teaching approach

7. Tutorial relationship with assistant
    - being able to get one-on-one help when needed
    - helpful assistant

8. Examples, layout of lessons, and small steps
    - examples
    - clear, easy to use CD-ROM
    - organized
    - lessons broken down into small steps
    - having weekly assignments

9. Narration
    - narration helpful, when could be heard
    - preferred narration over written instructions

The students also were asked “What did you like least about the HTML lessons and assignments?” Their actual responses and the identified response categories appear below.

1. Time consuming
    - too time consuming
    - competed with other assignments

Appendix Q (Continued)

2. Courseware layout
   - difficult to navigate
   - not able to bookmark, had to start from index every time
   - need print option on reference material
   - not well organized
   - flipping between notepad and courseware
   - flipping between assignments and lessons difficult with only one window available, have two instead
   - CD-ROM not user-friendly

3. Instruction not adequate
   - vague, hard to understand
   - needs more detail, especially later assignments
   - insufficient supplemental resources
   - need handouts
   - needs more examples
   - need examples that match the assignments more closely
   - there were mistakes
   - unnecessary material covered added to confusion
   - needed help section
   - needed FAQ section
   - needed trouble-shooting section
   - break information down more

4. Assignment requirements not clear
   - not clear what to do
   - missing important information
   - assignment 5 on images

5. Material and assignments too hard
   - too hard for students with little to no computer experience
   - not geared toward the computer novice
   - project scarey
   - terminology a barrier for novice students

- lesson on HTML terminology first
- material too hard
- assignments required previous knowledge of HTML
- some assignments did not match tutorial examples
- assignments harder than tutorial examples, always required something more
- (later) assignments too hard
- assignments too long
- too many assignments
- hard to match examples shown
- too much research required for ergonomics assignment

6. Prefer alternative teaching paradigm
    - CD-ROM should be supplemental, not primary resource
    - information not covered in class
    - should take questions and discuss material in class
    - teacher should be sole provider of course information
    - rigid format without live help
    - just a way for the instructor to be lazy
    - it should be a group project
    - should be done in lab setting with small number of students each at a computer
    - allow more group work
    - individual assignment due dates not announced in class, had to have computer to review them
    - no one to talk to
    - no teacher available to help
    - not having face to face discussions
    - demonstrations would be helpful

7. Narration
    - narrator did not hold attention
    - narration boring
    - same voice over and over
    - said the same thing every time the CD-ROM started

- narration forced me to go faster than desired
- not geared toward visual learners
- should have textual instructions as well
- no written instructions accompanying narration
- provide printed booklet as well
- use less voice prompts
- it gets really annoying when you're frustrated
- a bit wordy

8. Technical difficulties
   - CD-ROM of poor quality
   - not given password
   - CD-ROM got corrupted
   - CD-ROM crashed
   - CD-ROM not compatible with Macintosh
   - home computer developed a virus
   - not readable in some labs on campus
   - should use professional to record narrations, narrator not clear
   - narrators voice seems stiff
   - narration choppy

9. Submission procedure
   - did not like submission procedure
   - submit with floppy instead of electronically
   - transformation of work during transmission
   - work not being received when sent
   - not clear how to submit assignments
   - submission process unclear

10. No sound
    - no sound
    - volume too low

11. Material not stimulating and relevant
    - boring
    - unable to pursue a more creative direction
    - only programmers need this information
    - focus should be on teaching, not building a Web page
    - not sure how assignments help teachers
    - focus was on technical tools, not educational applications of them
    - assignments monotonous
    - material redundant

12. Prefer WYSIWYG (What you see, is what you get.)
    - page making programs easier to use and more understandable
    - HTML is obsolete with all of the shortcuts built into other programs
    - did not like having to use Notepad
    - HTML outdated, Flash 4.0 is the wave of the future
    - teachers do not need HTML
    - why are we learning HTML when other easier, more time efficient programs exist

13. Interaction with teaching assistants and instructors
    - assistants took 6-7 days to respond to e-mail
    - delay in grading too long
    - corrective feedback inadequate
    - hard to ask questions
    - no night time office hours
    - hard to get to assistants' office hours
    - assistants' not always there during office hours
    - no help from course assistant
    - assistants (and professor) did not know how to do the assignments
    - assistant had still not tried assignment 2 days before it was due
    - assistants not willing to help

14. Deadlines
    - differed from how other deadlines were handled in the class
    - first assignment due too soon
    - CD-ROMs needed to be distributed earlier
    - spread out deadlines more
    - have one assignment due per week
    - don't have 2 assignments due on the same day
    - not have 3 and 4 due at same time
    - should have late deadline for last two also
    - forced to move on before ready due to deadlines
    - pace seemed harried
    - assignments rushed
    - felt torn - turn it in on time and not understand or understand and turn it in late for no points
    - not enough time to complete assignments
    - have no deadlines
    - I needed more time

15. Unfair grading
    - it hurt our grades
    - grading unfair
    - should not have been graded
    - make it for extra credit
    - worth too many points (relative to other labs)
    - assignments worth too many points
    - not worth enough points for the amount of work it took
    - point distributions for individual assignments not appropriate
    - grading rubric too strict
    - I received zeros when I did the work
    - I thought it worked, but lost points
    - having a posttest where reference material is not available

16. Forced participation in study
    - felt like forced to participate in a study
    - felt like a lab rat

Appendix Q (Continued)

- people got different parts of the assignments
- the software was tested on us
- different deadline contingencies unfair

17. Feeling of failure and defeat
    - I did very poorly
    - I failed this lab
    - I couldn't even complete some of the assignments
    - I just kept guessing until it looked right
    - made me not want to learn more about computers
    - frustration and disappointment in never getting it to work
    - I had to have 100% help
    - all we did is copy, not really learn
    - frustrating when I couldn't get it to work
    - my own procrastination
    - always having to ask for help and stress about it
    - I did not receive full credit for anything
    - I almost gave up on the whole thing
    - I needed a lot of assistance
    - It would have been nice to have ended up with an actual web page
    - I gave up

Finally, the students were asked "What recommendations would you make for improving the courseware and/or assignments?" Their actual responses and the identified response categories appear below.

1. Either reduce the amount of work or give more time to complete it.
    - don't make 2 big assignments due each week
    - break longer assignments into smaller steps
    - less material
    - kill section on ergonomics
    - longer time to do work

Appendix Q (Continued)

2. Provide more assistance.
   - 24 hour hotline
   - do it in a lab with teacher on hand to answer questions
   - hand disks out in lab and address problems together right away
   - FAQ button

3. Augment course material.
   - detailed, step by step instructions for completing assignments
   - more examples
   - solution code after submission
   - fill in missing information for assignment 5

4. Alter the instructional paradigm somewhat.
   - have some lecture also
   - allow for more creativity
   - allow students to submit work in groups

5. Make sound accessible on more machines and easy to mute.
   - fix sound to work on more machines
   - put on a mute button

6. Provide option for printed material.
   - print syllabus at least
   - booklet to accompany CD-ROM
   - print option on reference material

7. Make HTML unit extra credit rather than required.
   - extra credit instead

Appendix R
Survey on Platform and Browser Usage

1. Place an X next to the location of the computer you most often use to complete class assignments.

    ______ home
    ______ open use lab in Education
    ______ other open use lab on campus (please specify which one: ______)
    ______ other (please specify: __________)

2. Place an X next to the type of computer you most often use to complete class assignments.

    ______ PC with Windows 98
    ______ PC with Windows 95
    ______ PC with Windows (not sure if 95 or 98)
    ______ MAC
    ______ other (please specify: __________)

3. Place an X next to the browser you most often use.

    ______ Netscape Navigator 3
    ______ Netscape Navigator 4
    ______ Netscape Navigator 4.6
    ______ Netscape Navigator 4.7
    ______ Netscape Navigator (not sure which version)
    ______ Internet Explorer 4
    ______ Internet Explorer 4.5
    ______ Internet Explorer 5
    ______ Internet Explorer (not sure which version)
    ______ AOL
    ______ Other (please specify which one: __________)

Appendix S
C Code to Analyze Data Via Randomization

```
/*************************************************************************
* Copyright 2001, Tina L. Majchrzak, All Rights Reserved
* Permission is granted to any party to use this code for research
* purposes, provided that this original copyright notice is retained
* and all changes to the original code are clearly identified.
*
* permProc.c was written in order to analyze the procrastination data
* for the dissertation entitled "Effects of Deadline Contingencies
* in a Web-Based Course on HTML" by Tina L. Majchrzak.  To the best
* of her understanding, the procedures outlined by Bryan F.J. Manly
* in "Randomization, Bootstrap and Monte Carlo Methods in Biology",
* second edition (1997), were followed.
*
* The method of generating random numbers worked on a PC running Linux.
* It may need to be adapted for alternative platforms.
*
* The code was compiled into an executable with the following command.
*   gcc -o permProc permProc.c
*************************************************************************/

#include <stdio.h>
#include <stdlib.h>

#define N 136
#define R 48
#define C 47
#define A 41
#define ITERATIONS 1000000.0 // for precision to the thousandths place

float average (float a[], int start, int end);
void  permute (float d[], int num);
void  swap (float d[], int loc1, int loc2);
float stat_rca (float d[], int num);
float stat_rc (float d[], int num);
float stat_ra (float d[], int num);
float stat_ca (float d[], int num);

void  dump_array (float a[], int num);
void  read_in (char fname[], float p[], int start, int end);
void  display (char * test, float s0, float p_value);
```

```
int main (void)
{
  int    i, cnt;
  float  p[N];
  float  s0, s, p_value;


  //****************************************
  // Omnibus test, considering R, C, and A.

  // Read the data from three separate data files into a single array p.
  read_in ("procR.dat", p, 1, R);
  read_in ("procC.dat", p, R+1, R+C);
  read_in ("procA.dat", p, R+C+1, R+C+A);


  // Calculate the test statistic for the original data.
  s0 = stat_rca (p, N);


  // Permute the data and generate the distribution of test statistics.
  cnt = 0;
  for  (i=1;  i<ITERATIONS;  i++)
  {
    //if ((i/100)==(i/100.0)) { printf ("working on iteration %d\n", i); }

    permute (p, N);
    s = stat_rca (p, N);

    // Count the number of test statistics that are less than s0.
    if  (s < s0)  cnt++;
  }


  // Calculate p-value.
  p_value = 1 - ((float) cnt)/ITERATIONS;


  // Display the results.
  display ("omnibus", s0, p_value);
```

```
//*************************************
// Two group test, considering R and C.

// Read the data from two separate data files into a single array p.
read_in ("procR.dat", p, 1, R);
read_in ("procC.dat", p, R+1, R+C);


// Calculate the test statistic for the original data.
s0 = stat_rc (p, R+C);


// Permute the data and generate the distribution of test statistics.
cnt = 0;
for  (i=1;  i<ITERATIONS;  i++)
{
  //if ((i/100)==(i/100.0)) { printf ("working on iteration %d\n", i); }

  permute (p, R+C);
  s = stat_rc (p, R+C);

  // Count the number of test statistics that are less than s0.
  if  (s < s0)  cnt++;
}


// Calculate p-value.
p_value = 1 - ((float) cnt)/ITERATIONS;


// Display the results.
display ("R-C", s0, p_value);
```

```
//***********************************
// Two group test, considering R and A.

// Read the data from two separate data files into a single array p.
read_in ("procR.dat", p, 1, R);
read_in ("procA.dat", p, R+1, R+A);


// Calculate the test statistic for the original data.
s0 = stat_ra (p, R+A);


// Permute the data and generate the distribution of test statistics.
cnt = 0;
for  (i=1;  i<ITERATIONS;  i++)
{
  //if ((i/100)==(i/100.0)) { printf ("working on iteration %d\n", i); }

  permute (p, R+A);
  s = stat_ra (p, R+A);

  // Count the number of test statistics that are less than s0.
  if  (s < s0)  cnt++;
}


// Calculate p-value.
p_value = 1 - ((float) cnt)/ITERATIONS;


// Display the results.
display ("R-A", s0, p_value);
```

```
  //*************************************
  // Two group test, considering C and A.

  // Read the data from two separate data files into a single array p.
  read_in ("procC.dat", p, 1, C);
  read_in ("procA.dat", p, C+1, C+A);


  // Calculate the test statistic for the original data.
  s0 = stat_ca (p, C+A);


  // Permute the data and generate the distribution of test statistics.
  cnt = 0;
  for  (i=1;  i<ITERATIONS;  i++)
  {
    //if ((i/100)==(i/100.0)) { printf ("working on iteration %d\n", i); }

    permute (p, C+A);
    s = stat_ca (p, C+A);

    // Count the number of test statistics that are less than s0.
    if  (s < s0)  cnt++;
  }


  // Calculate p-value.
  p_value = 1 - ((float) cnt)/ITERATIONS;


  // Display the results.
  display ("C-A", s0, p_value);


  return 0;
}
```

```
/*********************************************************************
* display prints out the test being conducted, the stastic for the
* original data, s0, the percentage of randomizations the statistic is
* greater than, 100-p_value*100, its significance level, p_value*100,
* and p_value.
*********************************************************************/

void display (char * test, float s0, float p_value)
{
  printf ("\ns0 = %.2f for the %s comparison and is greater than %.2f ",
          s0, test, 100-p_value*100);
  printf ("of\n  the randomizations, so s0 is significant at the %.2f ");
  printf ("percent level \n", p_value*100);
  printf ("  (p=%.4f).\n", p_value);
  return;
}

/*******************************************************************
* read_in reads data from the file fname and writes it to the array p.
* It begins writing at location start-1 of p and fills in the last
* value at location end-1 of p.  The only requirement is that the real
* numbers in the file be separated by white space.
*******************************************************************/

void read_in (char fname[], float p[], int start, int end)
{
  int i;
  FILE *in;

  if ((in = fopen (fname, "r")) == NULL)
  {
    printf ("Cannot open input file %s.\n", fname);
  }
  else
  {
    for  (i=start-1;  i<end;  i++)  { fscanf (in, "%f", &p[i]); }
  }

  return;
}
```

```
/************************************************************
* dump_array prints out the contents of the first num locations
* of the array a.  It is used for debugging purposes.
************************************************************/

void dump_array (float a[], int num)
{
  int i;

  for  (i=0;  i<num;  i++)  { printf ("%.2f ", a[i]); }
  printf ("\n");

  return;
}


/*******************************************************************
* stat_rca calculates the statistic of choice.  In this case, it
* calculates the omnibus test [(R-C) + (R-A) + |C-A|].
*******************************************************************/

float stat_rca (float d[], int num)
{
  float  ravg, cavg, aavg, s, tmp;

  // First, determine the means for groups R, C, and A.
  ravg = average (d, 1, R);
  cavg = average (d, R+1, R+C);
  aavg = average (d, R+C+1, R+C+A);
  //printf ("ravg=%.2f, cavg=%.2f, aavg=%.2f\n", ravg, cavg, aavg);

  // Next, calculate the appropriate difference and return it.
  // omnibus test for all groups, s0=8.23, p=.0012
  tmp = cavg - aavg;
  if (tmp < 0) {tmp *= -1;} // two-sided
  s = (ravg - cavg) + (ravg - aavg) + tmp;

  return s;
}
```

```
/*********************************************************************
* stat_rc calculates the statistic of choice.  In this case, it
* calculates the one-sided test (R-C).
*********************************************************************/

float stat_rc (float d[], int num)
{
  float  ravg, cavg, s;

  // First, determine the means for groups R and C.
  ravg = average (d, 1, R);
  cavg = average (d, R+1, R+C);

  // Next, calculate the appropriate difference and return it.
  // one-sided comparison of groups R and C, s0=4.11, p=.0005
  s = ravg - cavg;

  return s;
}

/*********************************************************************
* stat_ra calculates the statistic of choice.  In this case, it
* calculates the one-sided test (R-A).
*********************************************************************/

float stat_ra (float d[], int num)
{
  float  ravg, aavg, s;

  // First, determine the means for groups R and A.
  ravg = average (d, 1, R);
  aavg = average (d, R+1, R+A);

  // Next, calculate the appropriate difference and return it.
  // one-sided comparison of groups R and A, s0=0.80, p=.2710
  s = ravg - aavg;

  return s;
}
```

Appendix S (Continued)

```
/***********************************************************************
* stat_ca calculates the statistic of choice.  In this case, it
* calculates the two-sided test |C-A|.
***********************************************************************/

float stat_ca (float d[], int num)
{
  float  cavg, aavg, s;

  // First, determine the means for groups C and A.
  cavg = average (d, 1, C);
  aavg = average (d, C+1, C+A);
  //printf ("cavg=%.2f, aavg=%.2f\n", cavg, aavg);

  // Next, calculate the appropriate difference and return it.
  // two-sided comparison of groups C and A, s0=3.31, p=.0078
  s = cavg - aavg;  if (s < 0) {s *= -1;}

  return s;
}

/********************************************************************
* average returns the average of the values in array a starting at
* location start-1 and ending at location end-1.
********************************************************************/

float average (float a[], int start, int end)
{
  int   i;
  float sum=0;

  for  (i=start-1;  i<end;  i++)
  {
    sum += a[i];
  }

  sum /= (end-start+1);

  return sum;
}
```

```
/**********************************************************************
* permute randomly permutes the values in array a by starting at the
* end of the array, selecting a random value from that position
* forward, and swapping the contents of a at these two locations.  Then
* it repeats the process for the second to the last entry in a,
* continuing in like manner until it reaches the beginning of a.
**********************************************************************/

void permute (float a[], int num)
{
  int i, j;


  for  (i=num;  i>1;  i--)
  {
    j = (((float)random()/RAND_MAX)*i)+1;
    swap (a, i-1, j-1);

    //printf ("swapping %d and %d\n",i,j);
  }
}


/**************************************************************
* swap swaps the values in array a at locations loc1 and loc2.
**************************************************************/

void swap (float a[], int loc1, int loc2)
{
  float tmp;


  tmp = a[loc1];
  a[loc1] = a[loc2];
  a[loc2] = tmp;

  return;
}
```

Table 22. Student Responses on Achievement Measures

Id[a]	T[b]	Pretest	Posttest MC	Posttest Essay	Retention Test MC	Retention Test Essay
key		311221443	113433113413112332442222414321434422	111111111111	313412412	111111111111
100[c]	R	413213432	113213312314114312442232431321324131	100111100111	334232132	110100101101
101[c]	C	413414424	113433114411112332442232414321434432	111111101111	311112412	101001001110
102[e]	A	423333333	123123331412123113323142333424123000	000000000000	132141142	000000000000
103	A	413423324	141433431412114332244233122314431122	101101000000	211222132	000000000000
104[c]	C	313412434	142433214313142331243134132124144432	111111100111	332411442	101101001111
105	R	424414412	341423311413111322442224412323334432	101111111111	414122432	101101111111
106[ce]	R	413214443	121433210310113342442222434124431234	101000100000	313412412	000000000000
107[d]	A	433221114	------------------------------------	------------	334142332	100101101101
108	R	133212244	342133231241112312342114411114434433	100100000001	334222132	101100000001
109	R	413213234	142433413413112332442224414324114422	101111111101	314112222	101101001101
110	C	214234434	141423213413122332443211324124111442	101101100001	334422112	101101101000
111	A	423221321	142333114422121312313244113111141422	111100000001	232112012	111101000000
112	C	323242134	213113213443311314441114411322444220	101101100100	332412432	101100001110
113	R	433214344	341413332412111312423434433124121334	000000000000	---------	------------
115	C	343212432	414113323131143124411334343244214422	101101101011	311432212	101101001101
116[d]	R	134214231	141133213413111312412124222321331334	100001100101	434443332	100101100101
117[c]	R	133414224	343413212422111312443234434121444432	110101101011	134412312	101101101100
118	A	423413121	333133333114121343321121334124431232	000000000000	412241112	000000000000
119	C	433211134	------------------------------------	------------	---------	------------
120[h]	A	434214231	------------------------------------	------------	---------	------------
121	A	423211142	144223113412141312242124432323421432	111101000111	114111432	101100001101
122[dl]	A	424211434	243133433113143322342213231124111211	000000100001	434422432	001101001001
123	A	231213223	431413213423312312243223134321431444	001000100111	313212412	000100001111
124[dei]	A	413414114	341133212414112332441241412124431432	101111100001	412143434	000000000000
125	A	433411134	142413111311112132442121114321434132	111101100111	414512432	101101100111
126	R	331211432	142433312310112332442221214321434432	110111111111	313431412	101111100111
127	C	31-211324	313313412111311342441234434121321432	111101000101	111212232	111100000111
128	C	243211424	241113214413112342441214124324431432	111111100101	414212432	101111100101
129[d]	R	333214234	342132213412133311323423314424441332	000000000000	234242312	000001000000
130	C	233231134	122243313423122342334233132324422432	100101000000	434412132	100101000101

(table continues)

Table 22. *(continued)*

Id[a]	T[b]	Pretest	Posttest MC	Posttest Essay	Retention Test MC	Retention Test Essay
key		311221443	113433113413112332442222414321434422	111111111111	313412412	111111111111
131[d]	C	223214114	123133113444141312443424134314131331	110101000101	111141132	011100000000
132[c]	R	431421314	113433113213112332442223414111434422	111111111111	313112432	100111011111
133	A	414411414	142123112112141111321113241221332413	000000000000	423231212	000000000000
134	C	323211414	4131232134121323422241224132324421332	101110010100	231442132	101101000000
137	R	342214422	421413112413112342444213111122441432	110101000000	334212432	101100000000
138[c]	R	322224144	143133213413113112443234414314121442	111100101101	334412412	101101001001
139[e]	R	233414123	142133213312112342412214432144134422	101101101001	311312314	000000000000
140	A	413211234	123433133423112312323421234121431232	000101000000	432111312	000000000000
141	C	413211234	114413432414111342423224312122411331	000000000000	324422132	100101000000
142	R	433214431	223433212412111312143124434324443341	111111100001	434212232	101111000000
143	R	413213414	313143314314123331344144134312431424	100100000000	431122312	001101001000
144	A	343213234	242233224422211322441124131132433434	101000100111	321421432	100100100000
145	R	433413411	223133030312112311423124132124431132	000000000000	434431332	000000000000
146[c]	R	413214244	224133213422112112341214333124421132	000000000000	444211332	000000000000
147	R	143211424	243433212412111341342234132121134233	100100000000	344432232	100000000000
148	A	---------	113133313323112332442431414324434412	101101101111	311412112	101101101110
149	C	413211434	343133214413112332442223414121431432	111111111111	313112332	101111001111
150	R	---------	113134114412141333321213111344131412	100100000001	334212132	001000001100
151[e]	A	323443232	142443210412112343412214432124431322	101100100000	432112322	000000000000
152	C	213214232	141133213423123142341121334311241323	101101100001	414411332	101001001000
153	C	434211411	341223113313131312212113344124421333	010100000101	434233142	110100100101
154	C	323243223	------------------------------------	------------	---------	------------
155	A	214211234	144242212112122232323224321331334333	000000000000	434111132	000000000000
156	C	333224123	------------------------------------	------------	---------	------------
157[c]	A	423214431	131233313414213311442134331424241134	101111100000	233212332	101100100000
159	C	433214124	223433212412111312443124434324443341	111101100001	314441342	101100000100
160	A	434211422	322133234312232323431122323144231323	000000000000	444214232	000000000000
161	R	233213412	------------------------------------	------------	---------	------------
162[c]	R	412233434	142333213424111142233132234424431131	000000000000	431312000	000001001000
163	A	433212144	422133214312111322441212434311323122	100101100000	424321432	101100100000

(table continues)

Table 22. *(continued)*

Id[a]	T[b]	Pretest	Posttest MC	Posttest Essay	Retention Test MC	Retention Test Essay
key		311221443	113433113413112332442222414321434422	111111111111	313412412	111111111111
164	A	233213232	241113213413112332441324424314441434	111101110011	314211332	111101001000
165	R	414211134	112333212113111312241424434124444322	001001100000	434242332	001100001000
166	C	133212434	133433113313112342441222414321334412	110111000111	331212332	110101001111
167	A	---------	443143212314131341312234144114424433	101001001001	324331134	101101000101
168	R	423211432	------------------------------------	------------	443111222	000000000000
169	R	113214224	------------------------------------	------------	343441234	000100000000
170	A	- 43244132	------------------------------------	------------	---------	------------
171	C	133415531	------------------------------------	------------	---------	------------
172	A	111213412	223133112313111324231331343242224341	101100100111	214241132	101000001111
173[j]	C	213214244	222333212413112332453123314124134442	101100100000	212422234	000001000000
174	C	414213114	343133412313111312443224114124121431	101100100001	432212332	111101000000
175	C	433214134	144243212413144312422123224414321332	100001000000	231220132	000101001001
176	C	313214234	434143213343214312423124234324123431	000000000000	434122132	000101000000
177	A	11323----	414433213413112332442221414324434442	111111111111	331212332	111111011111
178	R	223214134	221423132112113312441431204114314422	110000010000	134242132	101000000000
179	R	433214324	421413112413112342442213111122441432	110100000000	245232312	000000000000
180[d]	C	312221311	142333112313111322441243434311331422	110100000100	431211132	111100000000
181	A	433211222	------------------------------------	------------	---------	------------
182[e]	A	232213223	------------------------------------	------------	441231232	000000000000
183[c]	C	134214132	313433314313112312442223114324434422	111111111111	313412412	101111111111
184	A	323212331	2331332134121133323422244432114431421	101101101001	111331432	100100000000
185	C	133211434	342413213114111312142123214324411333	111101000001	214212432	011101001100
186	C	134414434	313433313413112132442223114324444422	101111111111	211132212	101101101101
187	A	113311132	333333333333333333333333333333333333	000000000000	232111231	000000000000
188	A	424223432	423443213121143112243241134124341442	101101000000	332412112	001100001001
190	A	132211431	3422341134-3113332341234434114431422	101000100001	234411332	101101100000
191[d]	C	334214412	122421213324111312242124122221441231	000000000000	114131132	000001001000
192	R	433223132	123413114412112212442231414311434324	001111100111	311142132	001110001111
193	A	413212313	142413213443142332343144134211121432	110101000000	132412432	101101001000
194	R	232211223	442443232412312312223224324344341423	001100000000	334211332	000100000001

(table continues)

Table 22. *(continued)*

Id[a]	T[b]	Pretest	Posttest MC	Posttest Essay	Retention Test MC	Retention Test Essay
key		311221443	113433113413112332442222414321434422	111111111111	313412412	111111111111
195	C	413214133	123313212414121112323211222324121344	000000000000	431122342	000100000000
196	C	423423122	211433113312311141342424134111434432	101110110111	313432412	101001100111
197	A	433314124	441123312411343322323221334124423333	101001000000	334241342	001000001000
198[c]	R	313212445	142432213312322314221234134322421132	011101100000	133241234	001100000000
199[d]	R	123214233	------------------------------------	------------	134242332	101000000000
200	R	133211422	------------------------------------	------------	333241242	000000000000
201[d]	R	433214234	312433311311112332441224412341444232	101001101111	414232332	101101001111
202	C	323123224	243413212111112312443214414321431311	000000000000	322122131	000000000000
203[d]	A	232233214	------------------------------------	------------	413112432	101101011111
204	R	223414114	122123414323111322333234221114411333	010100000000	434111134	000000000000
205[cd]	C	212211432	144133212422114332323241334121414432	101000000000	334421132	001100001000
206	R	413214314	343131214411111312443134134122431132	011100000001	424431132	100100000001
207[d]	C	223411422	433433113413112122441444231311434412	111101100101	334412432	101100100100
208	A	233211224	302133122422111322442223412324434322	111101100101	314112412	101101001101
209	C	223221214	213433213414211112442124134124411132	000100000000	312112122	000101000000
210	A	433214334	333333313322212222223421134124431232	000000000000	434411424	000000000000
211[d]	R	113212422	------------------------------------	------------	---------	------------
212[h]	A	434212434	------------------------------------	------------	---------	------------
213[d]	A	223211434	122133313213122312321132324224131311	000000000000	234111432	000000000000
214	C	333212424	132433314311112332441123134343441412	111001000101	311431432	111001101111
215	R	313224424	342113211121112312422144314124121433	001000000000	434111212	000000000000
216	R	413223332	242433113413111312442222414311434422	111110111111	411412112	111111001001
217	R	423413242	141133212313111312412124222321331334	000000000000	532141434	000000000000
218[dh]	C	233413232	------------------------------------	------------	---------	------------
219[e]	R	113213144	------------------------------------	------------	234121344	000000000000
220[h]	A	433113432	------------------------------------	------------	---------	------------
221[f]	A	443214443	142113212324112332342223434321431334	100111100101	214212332	101101101000
222[f]	A	133211432	------------------------------------	------------	---------	------------
223	R	423214431	243133212411121312221224313321131412	010100000000	435112232	010100001000
224[df]	A	232213244	243153413414314322343144133234332332	110101110000	433222322	101101000001

(table continues)

Appendix T (Continued)

Table 22. *(continued)*

Id[a]	T[b]	Pretest	Posttest MC	Posttest Essay	Retention Test MC	Retention Test Essay
key		311221443	11343311341311233244222414321434422	111111111111	313412412	111111111111
225	A	132222414	141423113313112332443222424341434432	100101100111	344422412	000101001111
226	C	--321----	-----------------------------------	------------	434441332	000000000000
227	C	134413324	123131111113141311242224132414321432	000100000000	332122112	000101101000
228	R	233214314	222233414413111351443124421121131441	111101100011	334212432	101101000001
229[d]	C	213411422	311133132312113332442213111114434234	100111111101	343212312	101111100101
230	R	213211141	143413213413112232441141414324431432	111101000101	314412332	001101001000
231	C	231314132	121143214323111322243223134311111432	101101100100	414322134	000000000000
232[h]	R	311411432	-----------------------------------	------------	---------	------------
233[ckm]	A	233214144	343413313413131332313224412144211442	101100000101	334232132	100100000110
234[h]	C	224214421	-----------------------------------	------------	---------	------------
235[hn]	R	413212243	-----------------------------------	------------	---------	------------
236	A	133224432	-----------------------------------	------------	431142332	000000000000
237	R	342215532	-----------------------------------	------------	334431342	000000000000
238	C	233211434	414413313442111332443124113224222113	100000110001	212113132	101000000000
239	C	331214214	123113314413312332322124413121431134	101101000101	322432132	101001001101
240	R	323234214	-----------------------------------	------------	334323132	000000000000
242	A	323234432	323123212443112342343124434124344332	000000000000	324331132	101100000000
243	R	434211134	441433112412141342223234133314111332	001000100101	134111232	001100001000
244	R	313412234	312413213313112332412221434324434422	101110111111	314412432	110101011111
245	C	413214413	421431213412311311243123332314431332	100000000000	232441234	000100000000
247	A	313414234	341133413312121312131121132131414332	000000000000	234241112	000101000001
248[e]	A	413214234	341423213313212321443124434124134443	000000000000	334122314	000000000000
250	R	113214124	133131114413143442241423134314431412	110100000000	331112332	000001000000
251	R	413211114	122131112443131412313444334114321313	000000000000	234111342	000000000000
252[de]	R	314211412	342122331442123324232112343421232133	000000000000	433141132	000000000000
253[d]	C	413222434	143133413342111334441122214321433432	100101100001	434112422	101101000000
254[e]	A	424234113	332113213412141132441123414123424422	111111001000	314122334	000000000000
255	A	423214312	342333113414112112342124434123441434	101001100111	311411112	101001101000
256	C	134223231	31343311341311233244222414321434422	111111111111	414212432	101111100111
257	C	233411144	432133213413111312442234112314242432	100001100111	233112132	100101000000

(table continues)

Table 22. *(continued)*

Id[a]	T[b]	Pretest	Posttest MC	Posttest Essay	Retention Test MC	Retention Test Essay
key		311221443	113433113413112332442222414321434422	111111111111	313412412	111111111111
258	C	313214434	142133113413112332442421414324434432	111111101111	343412432	110110100111
259	R	124212434	143133114412111332442344314314411242	111101101111	314122131	001101001101
260[d]	R	333211432	----------------------------------	------------	---------	------------
261	R	333221344	413433113413112332442222414321434432	111110111111	313412412	111111101111
262	A	413214414	311133212421142312343424134123433432	101101100000	331421122	101101100000
263[o]	C	113211132	413433114413112332442224414123331432	111111100111	313132312	101101101110
264	A	413214434	241233234113312412342141224123131243	000100000000	314431342	001100000000
265[d]	C	413214112	----------------------------------	------------	434141122	000000000000
266	C	423214443	223113411312111342343234231124131232	001000100000	432112112	101000101000
267	R	233221444	232223413114113312441212133312441113	100100100010	213131132	100101000000
268	A	134212211	334423114413344412323221322124334221	000000000000	334123314	000000000000
269	R	431214441	113433113414111132442221434311334422	101101111111	311112112	101101000110
270	A	413234234	112133313413211342442224414324431432	111100100111	111432434	101100101111
271	R	324414433	414433213413112332442223414321434422	101101111111	314412412	101111011011
272	A	233214224	342323214413323113443234133212231141	100000000000	---------	------------
274	C	113414244	242133113234112312342124414324434122	101100000101	313312432	101100001000
275	A	412231414	243133223414111343313114423124431232	100000000000	334442132	000100000000
276[h]	A	423214231	----------------------------------	------------	---------	------------
278[h]	C	233214324	----------------------------------	------------	---------	------------
279	R	123213433	313133413313112332442224414321434422	101111111111	011511312	101101011111
280	C	413233131	143233232412141212321121134124123243	000100000101	424141332	000100001000
281	A	413233421	123131213412111312343124334123441343	000000000000	432431444	000000000000
282	R	413213134	142423211413221332441124424124434433	101111100111	334212422	101101001101
283[c]	A	432111433	242124313422113112443113134114431333	000101001000	---------	------------
284	C	233211424	342133113413141312312223312124441422	101101000101	333112114	100101100001
285	C	213214444	213433111413113332412324432124331431	110100000101	231412432	100000000100
286	R	123213434	331123313113243311323124122134131311	000000000000	234442332	000000000000
287	C	433214334	243213312414311312443214412121441423	100100100101	214432432	100100001001
288	A	232231442	112421111341113342442421434321333123	111001101111	411432132	000000000000
289[h]	R	- 23212232	----------------------------------	------------	---------	------------

(table continues)

Table 22. *(continued)*

Id[a]	T[b]	Pretest	Posttest MC	Posttest Essay	Retention Test MC	Retention Test Essay
key		311221443	113433113413112332442222414321434422	111111111111	313412412	111111111111
290	C	313224432	442332413412212132323122133144241323	100000000000	332431444	100000000000
291	R	433414231	241132212313112323343434234324131332	111111101001	234441232	001100000000
292[g]	C	234114434	321423212411112332442434223424441432	101100000000	314132331	000000000000
293[g]	R	432211414	------------------------------------	------------	234411132	000000000000
294[gm]	A	413214314	------------------------------------	------------	---------	------------

Note. Dashes indicate missing data.

[a]Student identification number. [b]Treatment. [c]Essay graded twice for measure of intrarater reliability. Underlined items indicate those which were rated differently. [d]Took pretest two days later with EdTech's Exam 1. Because delay was relatively short, responses were kept. [e]Retention essay actually missing. Several essays had no name, so zeros were entered for students who had multiple choice data. [f]Received corrupt courseware CD-ROMs, so data removed. [g]Late adds not on initial roll who were randomly assigned to treatments later and received CD-ROMs by February 24. [h]Removed from formal analysis, because officially dropped course by week three of five week treatment interval. These students were missing the posttest and retention test and assignment data were incomplete. [i]Took posttest after retention test, so posttest treated as missing data. [j]Took posttest following day and retention test four days later in Student Disability Services location. Because delay was relatively short, responses were kept. [k]Accidentally skipped posttest item 36 and marked 37 as response 2, so a 2 was recorded for 36. [l]Punctuation in name caused problems with online submission of work, so data were removed. [m]Not on April 25 class roll. [n]Pretest items 8, 9, 10, and 11 shifted down, so corrected error by shifting back up. [o]Fixed incomplete erasure for item 8 on pretest.

Appendix T (Continued)

Table 23. Assignment Raw Data

		Initial Grade[c]								Bonus / Penalty[d]								Final Grade[e]								Procrastination[f]								
Id[a]	T[b]	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	R[g]
100	R	4	4	3	8	3	2	-	-	0	0	0	0	0	0	-	-	4	4	3	8	3	2	0	0	4	5	-1	-1	12	13	1	1	
101	C	4	4	3	8	4	3	-	-	-4	-1	0	0	-1	-1	-	-	0	3	3	8	3	2	0	0	4	3	-1	-1	3	3	1	1	
102	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
103	A	4	4	2	-	-	-	-	-	-4	-4	0	-	-	-	-	-	0	0	2	0	0	0	0	0	5	5	0	22	15	15	1	1	
104	C	3	4	3	8	4	4	4	4	0	0	0	0	0	0	0	0	3	4	3	8	4	4	4	4	0	0	0	-1	0	0	-1	-1	
105	R	4	4	3	7	4	4	4	4	0	0	0	0	0	0	0	0	4	4	3	7	4	4	4	4	0	0	-2	-1	-1	0	-12	-11	
106	R	3	3	3	-	3	3	-	-	0	0	0	-	-3	-3	-	-	3	3	3	0	0	0	0	0	1	1	0	22	15	15	1	1	
107	A	4	4	1	8	-	-	-	-	-4	-4	0	0	-	-	-	-	0	0	1	8	0	0	0	0	1	1	-6	-2	15	15	1	1	
108	R	4	4	3	8	2	3	-	-	0	0	0	0	0	0	-	-	4	4	3	8	2	3	0	0	0	0	0	0	-1	0	1	1	
109	R	2	4	2	-	3	3	-	3	0	0	0	-	0	0	-	0	2	4	2	0	3	3	0	3	-1	-1	17	22	11	11	1	0	
110	C	4	4	0	7	-	-	-	-	-4	-4	0	-7	-	-	-	-	0	0	0	0	0	0	0	0	7	7	4	4	15	15	1	1	3-4
111	A	4	3	-	-	-	-	-	-	0	0	-	-	-	-	-	-	4	3	0	0	0	0	0	0	-1	-1	22	22	15	15	1	1	
112	C	4	4	4	7	-	-	-	-	-4	-4	-4	-7	-	-	-	-	0	0	0	0	0	0	0	0	12	14	7	8	15	15	1	1	1-6
113	R	4	4	3	1	-	-	-	-	0	0	0	0	-	-	-	-	4	4	3	1	0	0	0	0	0	0	0	21	15	15	1	1	
115	C	4	4	4	7	2	0	1	3	-1	-1	0	0	-1	0	0	0	3	3	4	7	1	0	1	3	2	2	0	0	1	1	0	0	
116	R	4	4	4	7	2	3	-	3	0	0	0	0	-2	0	-	0	4	4	4	7	0	3	0	3	5	5	0	21	15	14	1	0	
117	R	4	4	3	-	-	-	-	-	0	0	0	-	-	-	-	-	4	4	3	0	0	0	0	0	0	0	0	22	15	15	1	1	
118	A	4	4	4	-	-	-	-	-	-4	-4	-4	-	-	-	-	-	0	0	0	0	0	0	0	0	11	11	13	22	15	15	1	1	1-4
119	C	1	4	1	-	-	-	-	-	-1	-4	-1	-	-	-	-	-	0	0	0	0	0	0	0	0	6	7	3	22	15	15	1	1	
120[i]	A	4	4	3	8	-	-	-	-	0	0	0	0	-	-	-	-	4	4	3	8	0	0	0	0	-1	0	-3	-2	15	15	1	1	
121	A	1	0	1	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5	0	0	0	0	-1	-1	-1	0	0	0	0	0	
122[h]	A	4	4	3	8	4	3	3	3	-4	-4	-3	-8	-4	-3	-3	-3	0	0	0	0	0	0	0	0	6	6	2	2	15	15	1	1	4
123	A	4	4	3	-	3	3	3	3	0	0	-3	-	0	0	0	0	4	4	0	0	3	3	3	3	0	0	3	22	-1	-1	0	0	
124	A	4	4	3	8	-	-	3	3	0	0	0	0	-	-	0	0	4	4	3	8	0	0	3	3	0	0	0	0	15	15	-1	-2	
125	A	4	4	3	8	3	3	3	3	-4	-4	0	0	0	0	0	0	0	0	3	8	3	3	3	3	4	4	-1	0	-1	-2	-1	-1	
126	R	0	4	3	7	4	4	3	4	0	0	0	0	0	0	0	0	0	4	3	7	4	4	3	4	9	9	2	4	4	4	-1	0	
127	C	0	4	3	8	3	3	-	4	0	0	0	0	0	0	-	0	0	4	3	8	3	3	0	4	0	0	-2	0	0	0	1	0	
128	C	3	3	4	8	1	2	1	3	0	0	1	-1	-1	0	0	1	3	3	5	7	0	2	1	4	0	0	-4	3	1	0	0	-4	
129	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	4
130	C	1	0	2	7	-	2	-	-	-1	0	0	0	-	0	-	-	0	0	2	7	0	2	0	0	3	3	-1	-1	15	-1	1	1	
131	C	4	4	3	8	2	3	1	3	0	0	0	0	-1	-1	0	0	4	4	3	8	1	2	1	3	0	0	-2	-2	3	3	0	0	
132	R	3	3	3	7	4	3	4	4	0	0	0	0	0	0	0	0	3	3	3	7	4	3	4	4	-1	5	-2	-1	-1	3	-1	-1	

(table continues)

Table 23. *(continued)*

		Initial Grade[c]								Bonus / Penalty[d]								Final Grade[e]								Procrastination[f]								
Id[a]	T[b]	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	R[g]
133	A	4	4	-	-	-	-	-	-	0	0	-	-	-	-	-	-	4	4	0	0	0	0	0	0	0	0	22	22	15	15	1	1	
134	C	3	4	3	-	-	-	-	-	0	-1	-1	-	-	-	-	-	3	3	2	0	0	0	0	0	0	3	3	22	15	15	1	1	
137	R	4	1	3	8	2	-	-	-	0	0	0	0	0	-	-	-	4	1	3	8	2	0	0	0	0	0	0	4	14	15	1	1	
138	R	4	4	4	8	-	-	-	-	0	0	0	0	-	-	-	-	4	4	4	8	0	0	0	0	11	24	17	17	15	15	1	1	
139	R	4	4	3	8	4	4	0	3	0	0	0	0	0	0	0	0	4	4	3	8	4	4	0	3	0	0	-1	4	-1	-1	0	0	
140	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
141	C	4	4	3	6	2	-	-	-	-4	-4	0	-1	-1	-	-	-	0	0	3	5	1	0	0	0	4	4	0	1	3	15	1	1	
142	R	2	4	2	4	-	2	-	-	0	0	0	0	-	0	-	-	2	4	2	4	0	2	0	0	-1	-1	-3	-1	15	-1	1	1	
143	R	4	4	2	5	1	2	-	-	0	0	0	0	0	0	-	-	4	4	2	5	1	2	0	0	0	0	0	2	14	14	1	1	
144	A	4	4	4	7	2	3	0	1	0	0	0	0	0	0	0	0	4	4	4	7	2	3	0	1	0	0	0	0	0	0	0	0	
145	R	4	4	4	-	-	-	-	-	0	0	0	-	-	-	-	-	4	4	4	0	0	0	0	0	5	6	-1	22	15	15	1	1	
146	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
147	R	0	4	3	5	-	-	-	-	0	0	0	0	-	-	-	-	0	4	3	5	0	0	0	0	0	6	5	21	15	15	1	1	
148	A	4	4	4	7	3	4	0	4	0	0	0	0	-3	-4	0	0	4	4	4	7	0	0	0	4	0	0	0	0	14	14	0	0	5-6
149	C	4	4	4	7	-	-	3	4	0	0	0	-7	-	-	0	0	4	4	4	0	0	0	3	4	0	0	-2	21	15	15	0	0	
150	R	3	4	2	-	-	-	-	-	0	0	0	-	-	-	-	-	3	4	2	0	0	0	0	0	0	0	21	22	15	15	1	1	
151	A	4	4	3	7	-	-	-	-	0	0	0	-7	-	-	-	-	4	4	3	0	0	0	0	0	0	0	0	7	15	15	1	1	3-4
152	C	3	4	3	5	-	-	-	-	-3	-4	0	-1	-	-	-	-	0	0	3	4	0	0	0	0	6	6	0	2	15	15	1	1	
153	C	2	4	2	1	-	1	-	-	-2	-4	0	0	-	0	-	-	0	0	2	1	0	1	0	0	5	7	0	0	15	0	1	1	
154	C	4	4	4	-	-	-	-	-	-1	-4	-4	-	-	-	-	-	3	0	0	0	0	0	0	0	3	10	4	22	15	15	1	1	
155	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
156	C	0	0	-	-	-	-	-	-	0	0	-	-	-	-	-	-	0	0	0	0	0	0	0	0	3	3	22	22	15	15	1	1	
157	A	3	4	3	7	1	1	1	3	0	0	0	0	0	0	0	0	3	4	3	7	1	1	1	3	-1	0	0	0	-1	0	0	-1	
159	C	3	4	2	5	-	3	-	-	-3	-4	0	0	-	0	-	-	0	0	2	5	0	3	0	0	4	4	-3	0	15	-1	1	1	1-2
160	A	4	4	-	-	-	-	-	-	0	0	-	-	-	-	-	-	4	4	0	0	0	0	0	0	-1	-1	22	22	15	15	1	1	
161	R	4	4	2	7	2	3	-	-	0	0	0	0	0	0	-	-	4	4	2	7	2	3	0	0	5	5	8	10	3	3	1	1	
162	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
163	A	4	4	2	6	-	-	-	-	0	0	0	0	-	-	-	-	4	4	2	6	0	0	0	0	0	0	-1	0	15	15	1	1	
164	A	3	4	4	5	3	3	2	3	0	0	0	0	-3	-3	0	0	3	4	4	5	0	0	2	3	0	0	-1	0	11	11	0	0	
165	R	4	4	3	6	2	-	-	-	0	0	0	0	0	-	-	-	4	4	3	6	2	0	0	0	17	25	21	21	14	15	1	1	
166	C	4	4	3	5	4	4	1	3	0	-1	1	0	0	0	0	1	4	3	4	5	4	4	1	4	-1	1	-4	-1	-1	-1	-3	-4	
167	A	4	4	3	6	1	-	-	-	0	0	0	0	-1	-	-	-	4	4	3	6	0	0	0	0	0	0	0	0	14	15	1	1	

(table continues)

Appendix T (Continued)

Table 23. *(continued)*

		Initial Grade[c]								Bonus / Penalty[d]								Final Grade[e]								Procrastination[f]								
Id[a]	T[b]	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	R[g]
168	R	4	4	4	2	1	3	0	3	0	0	0	0	0	0	0	0	4	4	4	2	1	3	0	3	11	11	21	21	14	14	0	0	
169	R	1	4	0	8	0	0	0	0	0	0	0	0	0	0	0	0	1	4	0	8	0	0	0	0	26	26	19	19	12	12	-2	-2	
170	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
171	C	4	4	3	5	-	-	-	-	-4	-4	-3	-5	-	-	-	-	0	0	0	0	0	0	0	0	12	12	10	21	15	15	1	1	
172	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
173	C	4	4	4	7	-	-	-	-	-1	-1	0	-7	-	-	-	-	3	3	4	0	0	0	0	0	3	3	0	4	15	15	1	1	7-8
174	C	4	4	3	7	1	4	4	4	0	0	0	0	-1	-4	0	1	4	4	3	7	0	0	4	5	-1	-1	0	0	4	4	-2	-4	5-6
175	C	4	4	3	7	4	4	0	4	-1	-1	0	0	-4	-4	0	0	3	3	3	7	0	0	0	4	3	3	0	0	12	12	-2	-2	5-6
176	C	4	4	3	6	-	-	-	-	0	0	1	0	-	-	-	-	4	4	4	6	0	0	0	0	-1	-1	-4	-2	15	15	1	1	
177	A	4	4	4	8	4	4	4	4	0	0	0	0	0	0	0	0	4	4	4	8	4	4	4	4	0	0	0	0	0	0	-1	-1	
178	R	0	0	0	4	-	-	-	-	0	0	0	0	-	-	-	-	0	0	0	4	0	0	0	0	7	7	0	0	15	15	1	1	
179	R	4	4	1	8	2	-	-	-	0	0	0	0	-2	-	-	-	4	4	1	8	0	0	0	0	0	0	6	6	15	15	1	1	
180	C	4	4	3	8	4	4	3	4	0	0	0	0	-4	-4	0	0	4	4	3	8	0	0	3	4	-1	-1	0	0	4	4	-2	-1	
181	A	4	4	4	-	-	-	-	-	-4	-4	0	-	-	-	-	-	0	0	4	0	0	0	0	0	6	6	-1	22	15	15	1	1	
182	A	4	4	4	8	-	-	-	-	0	0	-4	-8	-	-	-	-	4	4	0	0	0	0	0	0	-1	-1	20	20	15	15	1	1	
183	C	4	4	4	7	4	4	4	4	0	0	1	0	0	0	0	0	4	4	5	7	4	4	4	4	-1	-1	-4	-1	-3	-3	0	-2	
184	A	4	4	4	7	4	3	2	3	0	0	0	0	0	0	0	0	4	4	4	7	4	3	2	3	-1	-1	-3	-1	-1	-1	-1	-1	
185	C	4	4	4	8	4	4	4	4	0	0	0	0	0	0	0	0	4	4	4	8	4	4	4	4	0	0	-1	0	0	0	-1	-1	
186	C	4	4	4	7	4	4	4	4	0	0	0	0	0	0	0	-4	4	4	4	7	4	4	4	0	-1	0	-1	0	0	0	0	1	
187	A	2	4	4	8	2	-	-	-	-2	-4	-4	-8	-2	-	-	-	0	0	0	0	0	0	0	0	28	28	21	21	14	15	1	1	
188	A	4	4	-	-	-	-	-	-	0	0	-	-	-	-	-	-	4	4	0	0	0	0	0	0	0	0	22	22	15	15	1	1	
190	A	0	4	4	7	0	4	1	-	0	-4	0	-7	0	-4	0	-	0	0	4	0	0	0	1	0	7	7	0	7	7	12	0	1	
191	C	4	4	3	7	2	-	-	1	-4	-4	-1	-1	0	-	-	0	0	0	2	6	2	0	0	1	10	10	3	3	0	15	1	-2	
192	R	4	4	3	8	3	4	1	4	0	0	0	0	-3	-4	-1	-4	4	4	3	8	0	0	0	0	27	27	20	20	15	15	1	1	
193	A	4	4	4	7	-	-	-	-	-4	-4	0	-7	-	-	-	-	0	0	4	0	0	0	0	0	5	6	0	6	15	15	1	1	
194	R	4	4	4	8	-	-	-	-	0	0	0	0	-	-	-	-	4	4	4	8	0	0	0	0	6	7	0	20	15	15	1	1	
195	C	-	4	4	-	-	-	-	-	-	-4	-1	-	-	-	-	-	0	0	3	0	0	0	0	0	29	4	3	22	15	15	1	1	
196	C	4	4	4	8	4	4	4	4	0	0	1	-1	1	-1	0	0	4	4	5	7	5	3	4	4	-2	-1	-4	1	-4	1	-1	0	
197	A	4	4	4	7	2	-	-	-	-4	-4	0	0	-2	-	-	-	0	0	4	7	0	0	0	0	7	7	0	0	14	15	1	1	
198	R	4	4	2	6	4	4	4	4	0	0	0	0	0	0	0	0	4	4	2	6	4	4	4	4	0	0	0	0	11	11	0	0	
199	R	4	4	3	6	-	0	-	-	0	0	0	0	-	0	-	-	4	4	3	6	0	0	0	0	13	13	6	6	15	13	1	1	
200	R	4	4	-	-	-	-	-	-	0	0	-	-	-	-	-	-	4	4	0	0	0	0	0	0	0	0	22	22	15	15	1	1	

(table continues)

Table 23. *(continued)*

Id[a]	T[b]	Initial Grade[c]								Bonus / Penalty[d]								Final Grade[e]								Procrastination[f]								R[g]
		1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	
201	R	4	4	4	8	3	4	3	4	0	0	0	0	0	0	0	0	4	4	4	8	3	4	3	4	0	0	-3	-1	11	10	0	0	
202	C	4	4	3	1	3	4	-	-	-4	-4	-3	-1	-3	-4	-	-	0	0	0	0	0	0	0	0	11	11	4	22	15	15	1	1	
203	A	4	4	4	8	4	4	4	4	-4	-4	0	0	0	0	0	0	0	0	4	8	4	4	4	4	4	4	-1	0	-2	-1	-1	-1	
204	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
205	C	4	4	4	-	1	2	-	-	-4	-4	-4	-	0	0	-	-	0	0	0	0	1	2	0	0	12	12	5	22	-1	-1	1	1	
206	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
207	C	4	4	2	7	1	3	-	-	-4	-4	-1	-1	-1	-3	-	-	0	0	1	6	0	0	0	0	5	5	2	3	5	14	1	1	
208	A	4	1	1	7	2	3	2	3	-4	-1	0	-7	0	-3	0	0	0	0	1	0	2	0	2	3	5	5	-2	3	0	3	0	0	
209	C	4	4	0	7	1	2	0	1	0	0	1	0	1	0	0	0	4	4	1	7	2	2	0	1	-1	-1	-5	-2	-4	-2	-3	-2	
210	A	2	4	4	8	2	-	-	-	-2	-4	-4	-8	-2	-	-	-	0	0	0	0	0	0	0	0	28	28	21	21	14	15	1	1	
211	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
212[i]	A	3	4	3	8	-	3	-	-	0	0	0	0	-	0	-	-	3	4	3	8	0	3	0	0	-1	0	-3	-2	15	-2	1	1	
213	A	3	4	1	-	-	-	-	-	-3	-4	0	-	-	-	-	-	0	0	1	0	0	0	0	0	4	6	-1	22	15	15	1	1	
214	C	0	0	0	0	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	0	0	-2	-2	-1	-1	-1	-2	
215	R	4	4	4	-	-	-	-	-	0	0	0	-	-	-	-	-	4	4	4	0	0	0	0	0	5	5	4	22	15	15	1	1	
216	R	4	4	4	8	4	4	0	4	0	0	0	0	0	0	0	0	4	4	4	8	4	4	0	4	6	6	3	3	14	14	0	0	
217	R	-	4	4	8	2	3	-	4	-	0	0	0	-2	0	-	0	0	4	4	8	0	3	0	4	29	11	4	21	15	14	1	0	
218[i]	C	2	4	-	-	-	-	-	-	-2	-4	-	-	-	-	-	-	0	0	0	0	0	0	0	0	10	10	22	22	15	15	1	1	
219	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
220[i]	A	4	4	-	-	-	-	-	-	0	0	-	-	-	-	-	-	4	4	0	0	0	0	0	0	-1	-1	22	22	15	15	1	1	
221[h]	A	4	4	4	8	1	4	-	4	-4	-4	0	0	0	0	-	0	0	0	4	8	1	4	0	4	7	7	0	0	0	0	1	0	
222[h]	A	4	4	3	7	3	3	4	-	-4	-4	-3	-7	0	0	0	-	0	0	0	0	3	3	4	0	12	12	5	5	-2	-2	0	1	
223	R	4	4	4	7	-	-	-	-	0	0	0	0	-	-	-	-	4	4	4	7	0	0	0	0	1	1	20	21	15	15	1	1	
224[h]	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
225	A	4	4	4	8	4	4	3	4	0	0	0	0	-4	-4	0	0	4	4	4	8	0	0	3	4	0	0	0	0	14	14	0	0	
226	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
227	C	4	4	4	8	-	-	-	-	0	0	0	-8	-	-	-	-	4	4	4	0	0	0	0	0	0	0	-2	14	15	15	1	1	
228	R	1	0	0	.	-	-	-	-	0	0	0	.	-	-	-	-	1	0	0	0	0	0	0	0	25	25	18	29	15	15	1	1	
229	C	4	4	3	3	3	3	0	-	0	0	0	0	0	0	0	-	4	4	3	3	3	3	0	0	0	0	-1	0	0	0	0	1	
230	R	1	0	3	8	2	4	3	-	0	0	0	0	0	0	0	-	1	0	3	8	2	4	3	0	0	0	21	21	14	14	0	1	
231	C	3	4	3	8	-	-	-	-	0	-4	0	0	-	-	-	-	3	0	3	8	0	0	0	0	-1	6	-1	0	15	15	1	1	
232[i]	R	4	4	3	-	-	-	-	-	0	0	0	-	-	-	-	-	4	4	3	0	0	0	0	0	-1	-1	-2	22	15	15	1	1	

(table continues)

Table 23. *(continued)*

Id[a]	T[b]	Initial Grade[c] 1	2	3	4	5	6	7	8	Bonus / Penalty[d] 1	2	3	4	5	6	7	8	Final Grade[e] 1	2	3	4	5	6	7	8	Procrastination[f] 1	2	3	4	5	6	7	8	R[g]
233	A	3	4	3	-	-	-	-	3	-3	-4	0	-	-	-	-	-3	0	0	3	0	0	0	0	0	5	5	0	22	15	15	1	1	
234[i]	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
235[i]	R	4	4	-	-	-	-	-	-	0	0	-	-	-	-	-	-	4	4	0	0	0	0	0	0	0	0	22	22	15	15	1	1	
236	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
237	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
238	C	4	4	4	7	2	3	2	3	0	0	0	0	0	0	0	0	4	4	4	7	2	3	2	3	0	0	0	0	0	0	0	0	
239	C	4	4	2	8	1	3	3	4	-4	-4	0	0	0	0	0	0	0	0	2	8	1	3	3	4	6	6	-1	-1	-2	-2	-2	-2	
240	R	4	4	4	8	4	4	-	3	0	0	0	0	-4	0	-	0	4	4	4	8	0	4	0	3	7	7	0	21	15	14	1	0	
242	A	3	4	3	6	4	-	-	-	0	0	0	-6	-4	-	-	-	3	4	3	0	0	0	0	0	0	0	0	21	15	15	1	1	
243	R	4	4	4	7	0	4	-	0	0	0	0	0	0	0	-	0	4	4	4	7	0	4	0	0	4	4	0	1	14	14	1	0	
244	R	4	4	4	8	4	4	4	4	0	0	0	0	0	0	0	0	4	4	4	8	4	4	4	4	0	0	0	0	-1	-1	-1	-1	
245	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
247	A	4	4	4	-	-	-	-	-	0	0	0	-	-	-	-	-	4	4	4	0	0	0	0	0	-1	-1	0	22	15	15	1	1	
248	A	4	4	2	-	-	-	-	3	0	0	0	-	-	-	-	0	4	4	2	0	0	0	0	3	-1	-1	-1	22	15	15	1	0	
250	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
251	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
252	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
253	C	4	4	4	7	0	0	0	-	-4	-4	0	0	0	0	0	-	0	0	4	7	0	0	0	0	4	4	-1	-1	11	11	0	1	
254	A	4	4	4	8	3	3	4	4	0	0	0	0	0	0	0	0	4	4	4	8	3	3	4	4	0	0	-1	-1	0	0	0	0	
255	A	4	4	3	7	0	3	-	4	0	0	0	-7	0	0	-	0	4	4	3	0	0	3	0	4	0	0	0	5	-1	0	1	-2	
256	C	4	4	4	8	4	4	4	4	0	0	1	0	1	0	1	1	4	4	5	8	5	4	5	5	-2	0	-4	-1	-8	-3	-14	-14	
257	C	4	4	3	7	3	3	3	4	-1	-1	0	0	0	0	0	0	3	3	3	7	3	3	3	4	1	1	-2	0	-1	-1	0	-1	
258	C	3	-	4	8	3	4	3	4	-3	-	-1	-1	-1	-1	-3	1	0	0	3	7	2	3	0	5	5	29	1	1	3	3	1	-4	
259	R	4	4	4	7	-	4	-	3	0	0	0	0	-	0	-	0	4	4	4	7	0	4	0	3	7	11	21	21	15	14	1	0	
260	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
261	R	4	4	4	7	2	4	2	4	0	0	0	0	0	0	0	0	4	4	4	7	2	4	2	4	-1	-1	-2	-2	-1	-3	-15	-15	
262	A	4	4	4	7	4	4	3	4	0	0	0	0	0	0	0	0	4	4	4	7	4	4	3	4	-1	-1	-1	0	0	0	-1	-1	
263	C	4	4	4	8	4	4	4	4	0	0	0	0	0	0	0	0	4	4	4	8	4	4	4	4	0	0	-1	0	0	0	-3	0	
264	A	4	4	-	-	-	-	-	2	0	0	-	-	-	-	-	0	4	4	0	0	0	0	0	2	0	0	22	22	15	15	1	0	
265	C	4	4	4	7	2	3	-	2	-4	-4	-4	-7	-2	-3	-	0	0	0	0	0	0	0	0	2	11	11	4	21	15	14	1	0	
266	C	4	4	4	7	-	-	-	-	-4	-4	-1	-1	-	-	-	-	0	0	3	6	0	0	0	0	6	6	3	3	15	15	1	1	
267	R	4	4	4	8	3	3	3	3	0	0	0	0	0	0	0	0	4	4	4	8	3	3	3	3	0	0	0	0	0	0	0	0	

(table continues)

Table 23. *(continued)*

		Initial Grade[c]								Bonus / Penalty[d]								Final Grade[e]								Procrastination[f]								
Id[a]	T[b]	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	R[g]
268	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
269	R	4	4	4	7	4	4	4	4	0	0	0	0	0	0	0	0	4	4	4	7	4	4	4	4	3	3	-1	0	0	6	-8	-1	
270	A	4	4	4	8	2	2	0	3	-4	-4	0	0	0	0	0	0	0	0	4	8	2	2	0	3	3	3	0	0	0	0	0	0	
271	R	4	4	4	8	4	4	4	4	0	0	0	0	0	0	0	0	4	4	4	8	4	4	4	4	28	28	21	21	14	14	0	0	
272	A	3	3	3	-	2	-	-	-	-3	-3	-3	-	-2	-	-	-	0	0	0	0	0	0	0	0	1	10	3	22	14	15	1	1	
274	C	4	4	4	7	4	4	4	3	0	0	0	0	-1	-1	1	1	4	4	4	7	3	3	5	4	0	0	0	0	1	2	-4	-4	
275	A	4	4	4	0	3	4	0	4	-4	-4	-4	0	-3	-4	0	0	0	0	0	0	0	0	0	4	6	6	21	21	14	14	0	0	
276[i]	A	4	-	-	-	-	-	-	-	-4	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	7	29	22	22	15	15	1	1	
278[i]	C	4	4	2	-	-	-	-	-	-4	-4	0	-	-	-	-	-	0	0	2	0	0	0	0	0	6	6	-1	22	15	15	1	1	
279	R	4	4	4	8	3	4	4	3	0	0	0	0	0	0	0	0	4	4	4	8	3	4	4	3	5	5	-2	0	1	1	-11	0	
280	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
281	A	4	3	4	7	-	3	-	-	0	0	0	0	-	-3	-	-	4	3	4	7	0	0	0	0	0	0	0	0	15	1	1	1	
282	R	4	4	3	8	4	2	-	-	0	0	0	0	0	-2	-	-	4	4	3	8	4	0	0	0	16	16	20	21	14	15	1	1	
283	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
284	C	4	4	3	7	2	2	-	1	-4	-4	0	0	0	0	-	1	0	0	3	7	2	2	0	2	6	6	-1	-1	-1	-1	1	-4	
285	C	4	4	4	8	4	3	1	3	0	0	0	0	0	-1	0	0	4	4	4	8	4	2	1	3	0	0	0	0	0	2	0	0	
286	R	4	4	3	8	1	3	-	-	0	0	0	0	0	0	-	-	4	4	3	8	1	3	0	0	0	0	17	18	14	12	1	1	
287	C	4	4	2	6	1	4	0	4	0	0	-1	-1	-1	-4	1	1	4	4	1	5	0	0	1	5	-1	-1	1	2	4	4	-4	-4	
288	A	3	4	3	6	0	2	-	-	-3	-4	0	0	0	0	-	-	0	0	3	6	0	2	0	0	4	4	-1	-1	-1	-1	1	1	1-2
289[i]	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
290	C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	
291	R	3	3	4	7	2	2	-	3	0	0	0	0	0	0	-	0	3	3	4	7	2	2	0	3	0	0	3	4	2	2	1	0	
292	C	4	4	3	8	3	4	4	4	0	0	-1	-1	0	0	0	0	4	4	2	7	3	4	4	4	0	0	3	3	-2	-2	-2	-2	
293	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	3-6
294	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0	0	0	0	0	29	29	22	22	15	15	1	1	

Note. Dashes indicate missing data.

[a]Student identification number. [b]Treatment. [c]Grade before application of bonus/penalty. [d]Amount added to (deducted from) grade for early (late) submissions as determined by treatment. The day after the treatment interval ended was used in those cases when the assignment was never submitted. [e]Grade after application of bonus/penalty. [f]Relative level of procrastination as determined by subtracting the due day from the submission day. [g]Assignments for which student requested a deadline extension. [h]Removed from study due to technical difficulties. [i]Removed from formal analysis, because officially dropped course by week three of five week treatment interval. These students were missing the posttest and retention test and assignment data were incomplete.

Appendix T (Continued)

Table 24. Profile and Preference Raw Data

Id[a]	T[b]	TA[c]	SG[d] B	SG[d] A	Prior[e] 1	Prior[e] 2	Collaboration[f] 1	2	3	4	5	E1[g]	Final[h]	Preference[i] 1	2	3	4	5	6	7	8	Best[j]	Least[k]
100	R	1			1.00	2.00	0	2	2	4	12	65	387	1	2	4	2	5	1	1	2	3	1,2,3,14
101	C	1			1.00	1.00	0	2	1	6	3	63	412	1	2	2	1	2	2	2	2	8	2,3,14,15,16
102	A	1			3.00	3.00	80	3	5	0	6	45	321	1	4	2	3	5	1	3	1	1	3
103	A	1			1.00	1.00	0	1	1	3	4	63	375	2	4	4	2	5	5	1	1	6	3,6
104	C	1			4.00	3.00	40	1	3	5	2	61	412	1	4	1	3	1	1	4	1	3	8,15
105	R	1			1.00	1.00	0	2	1	7	15	72	445	4	4	1	3	2	3	2	4	4	5,13
106[s]	R	1			1.00	1.00	0	2	2	6	13	51	169	5	3	1	2	1	1	1	5	4	3
107	A	1			1.00	$\boxed{1.34}$	–	–	–	–	–	60	340	–	–	–	–	–	–	–	–	–	–
108	R	1			1.00	1.00	80	5	2	5	10	50	360	1	2	4	2	2	1	5	2	2	3,14
109	R	1	1	21	1.00	1.00	40	1	3	4	5	65	400	5	4	5	1	5	5	1	4	4	3
110	C	1			1.00	1.00	0	4	5	1	7	57	374	1	2	2	3	4	2	4	2	1	3,5,6,11
111	A	1			1.00	1.00	0	1	2	2	4	63	399	2	2	4	3	5	4	2	2	1	1,2,3,5,6,15
112	C	1			1.00	1.00	0	2	1	4	10	55	369	2	2	1	5	3	2	4	2	1	3,8,10
113	R	1			1.00	1.00	0	1	1	4	3	44	152	1	2	4	4	2	1	2	4	8	3,13
115	C	1	15		1.00	1.00	0	2	4	6	12	55	397	1	2	1	1	5	1	1	2	3	5,6,15
116	R	1	5		2.00	1.00	20	1	3	5	5	39	309	3	2	3	4	3	3	3	3	3	3
117[s]	R	1			1.00	1.00	0	1	1	8	2	53	355	1	4	4	2	4	4	4	2	4	5,7
118	A	1			1.00	1.00	0	4	3	0	6.5	61	378	1	2	2	1	5	2	1	5	1	2,6,7
119	C	1			1.00	1.00	–	–	–	–	–	54	137	–	–	–	–	–	–	–	–	–	–
120[q]	A	1			1.00	1.00	–	–	–	–	–	57	180	–	–	–	–	–	–	–	–	–	–
121	A	1	7		2.00	2.00	0	2	4	6	9	47	364	1	2	1	1	4	1	1	1	3	3,5,9
122[l]	A	1			1.00	1.00	20	2	4	4	4	50	390	1	2	4	1	5	4	2	1	3	1,5
123[s]	A	1			1.00	1.00	0	2	3	8	6	63	398	2	2	4	1	4	1	2	2	8	3,12,14
124[t]	A	1			1.00	1.00	20	3	2	6	10	54	365	1	2	1	3	4	2	2	4	3	6,13
125	A	1			1.00	1.00	0	3	4	6	15	58	416	1	4	1	1	1	1	1	1	1	1,6
126	R	1			3.00	1.00	0	1	2	7	3	55	312	3	2	2	2	4	2	1	4	3	11
127	C	1			2.00	3.00	0	2	3	5	5	46	322	1	2	4	1	4	4	1	1	1	5,6
128	C	1			2.00	1.00	20	1	2	8	15	57	393	1	2	3	2	4	4	2	1	3	2,3,5
129[s]	R	1			2.00	2.00	0	2	2	1	3	55	332	1	2	5	1	5	5	1	1	3	10
130	C	1			4.00	2.00	–	1	5	5	6	54	357	1	4	5	1	1	1	1	2	1	2,3,5,9,11
131	C	1			3.00	1.00	0	3	3	8	15	41	330	1	4	4	5	1	3	3	3	3	3,6,11,13
132	R	1	1	21	3.00	3.00	20	1	3	7	8	69	427	4	2	2	3	2	3	3	4	4	8,15

(table continues)

Table 24. *(continued)*

Id[a]	T[b]	TA[c]	SG[d]		Prior[e]		Collaboration[f]					E1[g]	Final[h]	Preference[i]								Best[j]	Least[k]
			B	A	1	2	1	2	3	4	5			1	2	3	4	5	6	7	8		
133	A	1			1.00	1.00	0	2	3	2	6	59	314	1	4	1	1	1	1	1	1	1	2,5,6,14
134	C	1			1.00	1.00	0	2	5	0	6	63	363	1	3	5	1	5	4	2	1	1	3,5,7,8,10
137	R	1		31	1.00	1.00	40	1	1	5	5	56	391	1	4	4	4	4	4	1	1	4,9	5
138	R	1	3		2.00	3.00	0	1	1	4	3	67	424	1	4	2	1	5	4	2	2	3	2,3,5,6,8,10,14
139	R	1			1.00	1.00	0	2	4	5	4	58	400	2	2	4	3	4	4	4	2	3	3,5
140	A	1			1.00	1.00	40	2	2	0	4	59	349	1	2	5	3	5	5	3	1	1	3,11,12
141	C	1			1.00	1.00	–	–	–	–	–	54	360	1	2	4	4	4	2	2	1	4,9	6,7
142[s]	R	2			3.00	2.00	50	2	3	6	5	49	256	2	2	2	1	4	2	3	2	4	6,11,14
143	R	2			2.00	1.00	0	4	3	6	15	48	347	4	4	5	1	4	2	3	1	3	3,11,17
144	A	2	10		3.00	$\boxed{1.34}$	80	3	4	4	13	57	378	1	2	4	4	4	1	1	1	2,3	3,11
145	R	2			1.00	1.00	0	2	1	3	3	58	334	1	2	1	2	4	1	1	2	4	5,6,10,17
146	R	2			1.00	1.00	100	1	3	0	2	59	331	3	4	2	3	3	1	3	4	1	1,6,8
147	R	2			1.00	1.00	20	2	3	3	3	50	354	1	4	2	2	1	2	1	2	5	3,6,12
148	A	2			$\boxed{1.50}$	$\boxed{1.34}$	20	3	2	6	12	52	407	2	2	2	4	4	2	2	2	4	3,13
149	C	2			1.00	1.00	40	4	3	3	4	61	385	1	4	2	2	2	4	4	3	3	6
150	R	2	3		$\boxed{1.50}$	$\boxed{1.34}$	20	3	3	3	8	43	338	1	2	4	1	5	2	4	1	7	3,5
151	A	2			1.00	1.00	0	2	2	3	4	50	363	1	2	5	1	3	3	4	4	8	3,6
152	C	2			1.00	1.00	0	2	1	4	2	56	270	3	2	2	2	5	3	4	2	3	3
153[s]	C	2		32	1.00	1.00	20	1	2	6	12	47	282	1	1	1	1	5	1	2	1	1	3,13,17
154	C	2	13		4.00	2.00	–	–	–	–	–	61	375	–	–	–	–	–	–	–	–	–	–
155	A	2			2.00	1.00	0	2	1	0	1	32	296	1	2	2	4	5	2	3	1	1	3,5,6,13
156	C	2	15		2.00	1.00	–	–	–	–	–	39	90	–	–	–	–	–	–	–	–	–	–
157	A	2	8	23	1.00	$\boxed{1.34}$	80	2	2	3	15	46	406	1	4	4	1	2	1	1	1	4	5,6,12,13,16
159	C	2			1.00	1.00	40	4	2	1	4	42	348	1	2	3	1	3	5	3	2	1	6
160	A	2	8		3.00	3.00	0	1	1	2	0	55	362	2	4	4	2	4	4	2	2	1	5,17
161	R	2			1.00	1.00	–	–	–	–	–	49	142	–	–	–	–	–	–	–	–	–	–
162	R	2			1.00	1.00	0	1	2	0	2	46	209	2	4	5	2	3	4	1	2	4	6,8
163	A	2	10		1.00	$\boxed{1.34}$	20	1	1	3	6	48	371	1	2	4	5	4	4	2	1	1	3,5,6,15
164	A	2	8	23	1.00	1.00	80	3	3	3	15	52	372	1	4	1	5	3	2	4	2	3	3,8
165	R	2	19		2.00	$\boxed{1.34}$	0	2	2	5	5	55	382	1	2	1	1	5	1	1	1	8	3,17
166	C	2			2.00	1.00	0	2	1	7	15	56	391	2	4	3	3	2	2	1	1	4	1,3
167	A	2	9	22	$\boxed{1.50}$	$\boxed{1.34}$	80	1	2	5	5	39	330	4	4	2	3	2	2	2	4	4	3

(table continues)

Table 24. *(continued)*

			SG[d]		Prior[e]		Collaboration[f]							Preference[i]									
Id[a]	T[b]	TA[c]	B	A	1	2	1	2	3	4	5	E1[g]	Final[h]	1	2	3	4	5	6	7	8	Best[j]	Least[k]
168	R	2			2.00	2.00	–	–	–	–	–	36	209	–	–	–	–	–	–	–	–	–	–
169	R	2			1.00	1.00	–	–	–	–	–	63	325	–	–	–	–	–	–	–	–	–	–
170	A	2			1.00	$\boxed{1.34}$	–	–	–	–	–	47	90	–	–	–	–	–	–	–	–	–	–
171	C	2			1.00	1.00	–	–	–	–	–	47	234	–	–	–	–	–	–	–	–	–	–
172	A	2			2.00	1.00	0	1	1	0	0	57	366	1	4	4	1	4	4	2	1	–	–
173	C	2			1.00	1.00	0	4	1	4	15	49	366	4	4	1	5	4	1	3	1	3	14,16
174[u]	C	2		14	1.00	1.00	100	2	4	0	12	50	379	1	4	4	1	2	4	4	2	1	6,13
175	C	2	14	26	1.00	2.00	100	1	4	0	11	44	343	1	4	4	1	3	4	4	1	1	6,11,15
176	C	2			1.00	1.00	0	1	3	4	6	55	346	1	3	2	3	5	5	3	1	3	3,6
177	A	2			1.00	1.00	0	1	–	4	15	59	432	2	2	2	1	4	4	4	3	4	3,5
178	R	2			1.00	1.00	0	4	1	4	10	47	310	2	2	2	1	5	4	4	1	3	3,6,15
179	R	3		31	1.00	1.00	60	1	1	4	4	41	355	4	4	2	4	3	1	2	4	1	3,17
180	C	3	14	26	1.00	1.00	100	1	4	1	5	47	371	1	4	1	1	5	1	4	1	1	3,6
181	A	3			3.00	1.00	–	–	–	–	–	49	135	–	–	–	–	–	–	–	–	–	–
182	A	3			3.00	1.00	–	–	–	–	–	37	318	–	–	–	–	–	–	–	–	–	–
183	C	3	16	25	1.00	2.00	60	3	1	4	3.5	66	436	2	4	4	4	2	4	1	4	4,8	3,5,14,15
184	A	3			1.00	1.00	0	4	2	2	7	50	388	1	4	1	1	2	1	1	2	1	3,14,17
185	C	3	18		1.00	1.00	20	4	1	8	15	45	390	2	1	3	1	4	1	3	4	3	3,5,13,14
186	C	3	16	25	1.00	1.00	80	2	4	4	5	60	428	1	4	4	5	2	4	2	5	2,3	3,7,8,9,14
187	A	3		30	1.00	1.00	40	2	2	3	3.5	0	330	1	4	5	3	5	5	1	2	1	5
188	A	3			1.00	1.00	0	2	1	2	3	57	397	1	2	3	1	4	4	3	1	3	1,3,5,6,8,16,17
190[s]	A	3			2.00	1.00	0	1	1	8	5	47	323	1	2	3	3	5	1	3	3	3,8	3,13,14
191[s]	C	3			2.00	1.00	0	2	3	8	12	48	316	2	2	2	4	1	2	2	5	1	1,3,6,8,14,17
192	R	3			4.00	4.00	0	1	2	7	8	64	350	4	2	2	4	5	1	5	3	1	7,12,14
193	A	3	7		1.00	2.00	0	2	1	3	10	50	380	1	4	2	1	5	2	2	2	1	3,6,15
194	R	3	4		1.00	1.00	80	1	4	2	4	38	244	1	3	2	3	3	2	4	1	2	5
195[s]	C	3			1.00	1.00	0	1	2	7	4	50	374	1	4	2	2	1	1	2	4	2	5,6
196	C	3			1.00	1.00	0	1	1	8	1	68	432	4	2	2	1	3	4	1	4	4,8	3,8
197	A	3	9	22	1.00	1.00	100	1	3	0	6	32	283	1	4	4	3	4	1	2	1	9	3,7
198	R	3			1.00	1.00	60	2	4	3	10	31	366	2	4	4	3	4	4	3	3	5	1,5,11,17
199	R	3			2.00	3.00	–	–	–	–	–	46	336	–	–	–	–	–	–	–	–	–	–
200	R	3			1.00	1.00	–	–	–	–	–	49	202	–	–	–	–	–	–	–	–	–	–

(table continues)

Table 24. *(continued)*

Id[a]	T[b]	TA[c]	SG[d] B	SG[d] A	Prior[e] 1	Prior[e] 2	Collaboration[f] 1	Collaboration[f] 2	Collaboration[f] 3	Collaboration[f] 4	Collaboration[f] 5	E1[g]	Final[h]	Preference[i] 1	Preference[i] 2	Preference[i] 3	Preference[i] 4	Preference[i] 5	Preference[i] 6	Preference[i] 7	Preference[i] 8	Best[j]	Least[k]
201	R	3			1.00	1.00	80	3	2	6	6	54	396	2	2	2	5	5	3	2	2	2,3	6,13
202	C	3			1.00	1.00	20	1	3	6	5	64	372	4	5	2	2	1	1	3	4	4	3
203	A	3			2.00	1.00	–	–	–	–	–	57	408	–	–	–	–	–	–	–	–	–	–
204[s]	R	3			2.00	$\boxed{1.34}$	40	2	2	1	2	63	367	1	2	2	1	4	4	2	1	1	6,15,16
205	C	3			2.00	5.00	0	4	5	3	8	49	356	2	4	2	4	3	1	4	4	3,9	1,8,10,14
206	R	3		33	3.00	1.00	20	1	1	0	–	54	329	1	2	5	1	5	5	2	1	1	3,14
207	C	3	13		1.00	1.00	20	2	2	6	15	68	398	2	4	2	5	4	4	2	$\boxed{3}$	2	5,7,13
208	A	3			2.00	$\boxed{1.34}$	0	2	2	8	8	56	398	1	4	4	2	3	4	2	1	1	3,5
209	C	3			1.00	$\boxed{1.34}$	0	2	1	8	8	44	368	2	2	3	4	5	1	4	2	1	5
210	A	3		30	1.00	1.00	100	2	2	0	4	52	355	1	4	2	1	4	4	4	1	1	3,6,8,11,17
211	R	3			2.00	2.00	–	–	–	–	–	53	130	–	–	–	–	–	–	–	–	–	–
212[q]	A	3			1.00	1.00	–	–	–	–	–	56	173	–	–	–	–	–	–	–	–	–	–
213	A	3			1.00	1.00	0	2	3	3	6	40	361	4	2	1	2	1	2	2	3	3,6	3
214	C	3		32	4.00	3.00	20	5	2	8	15	55	410	1	2	1	3	3	1	1	1	1	1,3,4,7,15
215	R	3			1.00	1.00	0	2	3	2	4	57	380	1	2	4	4	4	4	2	1	1	3,6
216	R	3	4		1.00	1.00	0	1	2	8	4	60	409	5	1	5	5	5	5	1	5	4	3
217	R	3			1.00	3.00	100	1	2	0	2.5	45	282	1	4	1	5	5	5	5	1	1	–
218[r]	C	3			1.00	1.00	–	–	–	–	–	35	119	–	–	–	–	–	–	–	–	–	–
219	R	3	3		1.00	1.00	–	–	–	–	–	62	328	–	–	–	–	–	–	–	–	–	–
220[m]	A	4			2.00	4.00	–	–	–	–	–	62	169	–	–	–	–	–	–	–	–	–	–
221[l]	A	4			1.00	1.00	80	2	1	1	9	53	382	1	4	4	3	5	5	4	1	3	6,8,9,14
222[l]	A	4			4.00	3.00	–	–	–	–	–	60	215	–	–	–	–	–	–	–	–	–	–
223	R	4	19		2.00	1.00	0	1	1	4	6	53	376	1	2	1	1	5	1	1	2	4	3,6,13,17
224[l]	A	4			4.00	$\boxed{1.34}$	0	4	4	2	1	0	352	1	2	5	1	5	5	4	1	1	4,6,8,15,17
225	A	4	11	27	1.00	1.00	80	2	3	3	13	73	442	2	4	1	1	4	1	2	4	1	1,3,5,6,7,11,15
226	C	4			1.00	1.00	–	–	–	–	–	62	221	–	–	–	–	–	–	–	–	–	–
227	C	4			1.00	$\boxed{1.34}$	0	2	3	4	2	66	376	1	2	1	2	5	5	1	1	1	3,6,16
228[s]	R	4			1.00	1.00	0	3	1	5	15	55	400	1	1	1	1	1	4	1	2	3	3,6,13,14
229	C	4	17	24	1.00	1.00	20	2	1	7	10	58	381	3	2	1	4	3	4	2	3	4	3
230	R	4	3		1.00	1.00	0	1	5	1.5	11	55	386	1	2	4	1	4	1	1	2	1	3,5,13
231[s]	C	4	13		4.00	5.00	40	1	4	5	8	62	380	4	5	2	5	5	2	2	4	1	11,12
232[q]	R	4	2		1.00	1.00	–	–	–	–	–	63	166	–	–	–	–	–	–	–	–	–	–

(table continues)

Table 24. *(continued)*

			SG[d]		Prior[e]		Collaboration[f]							Preference[i]									
Id[a]	T[b]	TA[c]	B	A	1	2	1	2	3	4	5	E1[g]	Final[h]	1	2	3	4	5	6	7	8	Best[j]	Least[k]
233	A	4			1.00	1.00	0	1	3	2	10	0	364	3	2	2	3	3	2	2	4	3	1,4,14
234[o]	C	4			1.00	1.00	–	–	–	–	–	46	98	–	–	–	–	–	–	–	–	–	–
235[q]	R	4	2		1.00	1.00	–	–	–	–	–	53	119	–	–	–	–	–	–	–	–	–	–
236	A	4			1.00	1.00	–	–	–	–	–	67	208	–	–	–	–	–	–	–	–	–	–
237	R	4	3		1.00	1.00	–	–	–	–	–	54	286	–	–	–	–	–	–	–	–	–	–
238	C	4	17	24	2.00	2.00	60	2	4	3	10	45	375	1	2	5	1	5	2	2	1	4	3,5,8,13
239	C	4			2.00	1.00	40	2	3	4	7.5	46	398	1	2	4	3	5	4	2	2	8	3,5,6,12,13
240	R	4	5		3.00	4.00	–	–	–	–	–	44	322	–	–	–	–	–	–	–	–	–	–
242[s]	A	4			2.00	2.00	0	2	3	6	8	48	223	2	2	2	3	3	2	3	2	1	4
243	R	4			1.00	1.00	0	2	1	7	4	0	361	1	2	1	1	5	4	4	1	4	3,7,15
244	R	4			1.00	2.00	0	2	2	8	3	66	440	1	2	4	2	2	4	1	2	4,7	15
245[s]	C	4			2.00	1.00	0	4	2	1	8	57	322	2	4	2	3	2	4	2	3	3	4,5
247[s]	A	4	8		1.00	1.00	0	1	2	4	1.5	52	372	1	2	5	4	5	5	4	1	3	5,7,12,15
248	A	4	12	28	1.00	1.00	80	1	4	3	2	61	378	4	4	4	3	2	4	2	4	6	3,7,14
250	R	4		33	1.00	1.00	20	1	1	0	1	57	362	1	2	1	2	5	1	2	1	1	8,10
251	R	4	6		1.00	2.00	–	–	–	–	–	0	212	2	5	4	2	3	1	3	2	–	–
252[s]	R	4	6		1.00	3.00	0	1	3	7	4	31	275	4	2	4	4	4	4	3	3	1	5
253	C	4			1.00	1.00	60	2	1	3	6	57	369	2	2	2	3	3	2	2	2	4	1,6,8,13
254	A	4	10		1.00	1.00	0	1	5	1	7	62	403	1	2	5	5	5	4	2	1	4	5,11
255	A	4			1.00	1.00	60	2	3	2	15	46	330	1	2	1	1	5	1	2	1	1	3,5,13
256	C	4			1.00	2.00	0	2	2	8	4	69	449	4	5	2	2	2	2	1	5	3	4,8,14
257	C	5	18		1.00	1.00	80	4	5	1	10	52	372	1	4	1	1	4	1	2	1	3	5,6,17
258	C	5			1.00	1.00	0	4	3	3	8	69	421	1	2	5	1	5	4	1	2	3	2,3,4,7
259	R	5			1.00	1.00	0	3	1	6	15	51	366	2	4	4	1	4	5	2	4	3,4	1,3,8,14
260	R	5			1.00	1.00	–	–	–	–	–	40	98	–	–	–	–	–	–	–	–	–	–
261	R	5			3.00	2.00	0	2	2	6	3	51	398	4	5	4	2	2	4	1	4	3,4	13,15
262	A	5			1.00	1.00	0	1	2	8	4	55	400	4	3	2	4	2	4	2	5	2	3,14
263	C	5			2.00	1.00	20	2	1	7	4	59	407	2	3	2	1	2	4	2	2	3	3
264	A	5	12	28	1.00	1.00	40	3	3	2	2	71	382	3	2	2	4	5	3	4	4	1	3,6
265	C	5			5.00	4.00	–	–	–	–	–	39	245	–	–	–	–	–	–	–	–	–	–
266[s]	C	5			1.00	1.00	0	1	1	5	5	59	359	4	2	1	2	3	1	2	4	4	3,6,8,13
267	R	5			3.00	1.00	80	4	4	4	10	51	387	1	2	5	1	2	4	2	1	3	3,6

(table continues)

Table 24. *(continued)*

Id[a]	T[b]	TA[c]	SG[d]		Prior[e]		Collaboration[f]					E1[g]	Final[h]	Preference[i]								Best[j]	Least[k]
			B	A	1	2	1	2	3	4	5			1	2	3	4	5	6	7	8		
268	A	5			1.00	1.00	20	1	1	0	1	49	325	3	4	2	3	5	3	3	3	3,4	11
269	R	5			1.00	1.00	0	2	1	7	15	70	429	5	5	1	5	1	1	1	1	1	1,3
270	A	5			1.00	1.00	0	2	4	2	10.5	52	396	4	3	3	3	2	4	3	4	5	5,14
271	R	5			1.00	1.00	0	1	1	8	15	61	428	5	2	2	4	2	1	1	5	4	8,17
272[s]	A	5			3.00	2.00	20	1	5	7	10	36	130	5	4	1	5	1	1	4	5	2	3,11
274	C	5			1.00	1.00	0	1	1	8	5	66	422	2	2	2	4	4	2	2	2	2,3	2,3,7,15
275	A	5	11	27	1.00	1.00	100	–	3	0	4	64	331	2	2	3	4	4	2	1	4	1	5,7,8
276[p]	A	5			3.00	1.00	–	–	–	–	–	47	139	–	–	–	–	–	–	–	–	–	–
278[q]	C	5			1.00	1.00	–	–	–	–	–	50	136	–	–	–	–	–	–	–	–	–	–
279	R	5			2.00	1.00	0	2	1	7	5	63	404	1	2	5	2	1	1	4	2	3,6	3,6
280	C	5			1.00	1.34	0	2	1	0	4	0	317	2	2	2	2	4	1	2	2	3	5,6,13
281	A	5			1.00	1.00	0	1	5	0	2	54	383	2	4	4	1	1	4	3	4	4	11,12
282	R	5			1.00	1.00	0	1	1	6	3	56	403	2	4	2	2	4	2	2	2	3,4	3,14
283	A	5			1.00	1.00	0	1	2	0	0	51	153	2	4	2	2	2	1	2	2	4	5,8
284	C	5			1.00	1.00	0	3	1	5	6	65	391	1	2	4	3	4	4	5	1	3	3,5,13
285	C	5			4.00	3.00	0	1	2	8	5	52	386	1	2	2	4	2	4	4	1	–	–
286	R	5	3		3.00	1.00	0	2	3	2	4	62	376	2	2	4	1	4	1	4	2	3	3,6
287	C	5	14	26	2.00	1.00	80	1	1	3	15	42	352	1	2	3	1	5	2	1	5	1	6,14
288	A	5			1.00	1.00	20	5	1	0	8	65	425	1	3	5	1	5	2	3	1	1	3,6,7,17
289[n]	R	5			1.00	1.00	–	–	–	–	–	30	81	–	–	–	–	–	–	–	–	–	–
290	C	5			2.00	1.00	0	4	3	0	3	0	308	1	4	2	1	5	5	1	1	1	5,6,7,16
291	R	5			2.00	2.00	40	2	1	3	7	61	392	1	4	1	2	4	1	2	5	3	3,17
292	C	1			1.00	1.00	0	1	5	2	10	49	380	1	4	1	1	4	1	1	1	3	1,3,6,14

(table continues)

Table 24. *(continued)*

			SG[d]		Prior[e]		Collaboration[f]							Preference[i]									
Id[a]	T[b]	TA[c]	B	A	1	2	1	2	3	4	5	E1[g]	Final[h]	1	2	3	4	5	6	7	8	Best[j]	Least[k]
293	R	1			2.00	1.00	–	–	–	–	–	43	139	–	–	–	–	–	–	–	–	–	–
294	A	1			1.00	1.00	–	–	–	–	–	54	87	–	–	–	–	–	–	–	–	–	–

Note. Dashes indicate missing data. Values in boxes indicate missing data for which values were estimated in whole or in part.

[a]Student identification number. [b]Treatment. [c]Teaching assistant. [d]Study group. Students, prior to the treatment interval, anticipated being in the groups listed in column B. After the treatment interval, they reported that they were actually members of the groups listed in column A. [e]Self-report of prior experience with document formatting and programming/authoring languages (see Appendix F). [f]Self-report of collaboration level on HTML assignments (see Appendix P). [g]Scores on EdTech's Exam 1 with values in the range [0,73]. [h]Final class standing in EdTech with values in the range [0,449]. [i]Self-report of pacing preference (see Appendix K). [j]Report of what was liked best about the lessons and assignments (see Appendices P and Q). [k]Report of what was liked least about the lessons and assignments (see Appendices P and Q). [l]Removed from study due to technical difficulties. [m–r]Removed from formal analysis, because officially dropped course by week three of five week treatment interval. These students were missing the posttest and retention test and assignment data were incomplete. Each dropped on either March 2[m], 3[n], 7[o], 8[p], 9[q], or 10[r]. [s]Reported completing a larger number of assignments alone than actually submitted for grading. [t]Took pacing preference survey after retention test, so preference data treated as missing data. [u]Not identified in group 14 prior to study, but identified afterwards and included in group 26. Student was included in group 14 for analysis of preference data only.

Table 25. Scores for Individuals and Study Groups

			Achievement				Assignments			Class Points			Procrastination		
Id[a]	T[b]	G[c]	Pre	Post	Ret	Diff[s]	N[d]	NBP[e]	BP[f]	Before[g]	E[h]	Final[i]	Late[j]	Req[k]	Pref[l]
100	R		33.33	61.90	47.62	14.29	6.00	66.67	66.67	38.00	10.00	59.00	4.25		2.50
101	C		22.22	90.48	61.90	28.57	6.00	72.22	52.78	40.50	10.00	63.50	1.62		2.75
102	A		11.11	9.52	4.76	4.76	0.00	0.00	0.00	4.00	10.00	33.00	16.75		2.75
103	A		22.22	40.48	14.29	26.19	3.00	27.78	5.56	13.00	10.00	42.00	8.00		2.25
104	C		33.33	66.67	61.90	4.76	8.00	94.44	94.44	47.00	10.00	70.00	-0.38		3.25
105	R		11.11	79.76	66.67	13.10	8.00	94.44	94.44	51.00	10.00	70.00	-3.38		3.88
106[m]	R		55.56	39.29	42.86	-3.57	5.00	41.67	25.00	21.00	10.00	42.00	7.00		4.38
107	A		33.33	$\boxed{59.9}$	47.62	12.28	4.00	47.22	25.00	9.00	5.00	33.00	3.25		$\boxed{2.79}$
108	R		22.22	32.14	33.33	-1.19	6.00	66.67	66.67	33.00	10.00	54.00	0.12		2.38
109	R	1	22.22	82.14	57.14	25.00	6.00	47.22	47.22	36.50	10.00	57.50	7.50		2.75
110	C		33.33	52.38	52.38	0.00	4.00	41.67	0.00	13.00	10.00	36.00	6.75	2.00	2.50
111	A		33.33	41.67	42.86	-1.19	2.00	19.44	19.44	17.00	10.00	46.00	9.25		2.25
112	C		22.22	50.00	57.14	-7.14	4.00	52.78	0.00	12.00	10.00	35.00	9.12	6.00	3.12
113	R		22.22	13.10	$\boxed{16.13}$	-3.03	4.00	33.33	33.33	17.50	10.00	38.50	6.62		3.25
115	C	15	33.33	59.52	61.90	-2.38	8.00	69.44	61.11	35.00	10.00	58.00	0.75		2.75
116	R	5	11.11	46.43	38.10	8.33	7.00	75.00	69.44	37.00	10.00	58.00	7.62		3.00
117[m]	R		0.00	61.90	57.14	4.76	3.00	30.56	30.56	25.00	10.00	46.00	6.75		2.12
118	A		0.00	15.48	14.29	1.19	3.00	33.33	0.00	6.50	10.00	35.50	11.12	4.00	2.88
121	A	7	33.33	60.71	47.62	13.10	8.00	19.44	19.44	20.50	10.00	49.50	-0.38		2.75
123[m]	A		33.33	47.62	61.90	-14.29	7.00	63.89	55.56	32.50	10.00	61.50	2.88		2.50
124[n]	A		11.11	$\boxed{19.63}$	9.52	10.11	6.00	69.44	69.44	25.00	5.00	49.00	3.38		$\boxed{2.79}$
125	A		11.11	71.43	61.90	9.52	8.00	86.11	63.89	39.50	10.00	68.50	0.25		3.38
126	R		55.56	84.52	76.19	8.33	8.00	80.56	80.56	48.00	10.00	69.00	3.88		3.25
127	C		44.44	53.57	52.38	1.19	7.00	69.44	69.44	37.00	10.00	60.00	-0.12		2.00
128	C		33.33	66.67	61.90	4.76	8.00	69.44	69.44	39.50	10.00	62.50	-0.50		2.12
129[m]	R		22.22	15.48	19.05	-3.57	0.00	0.00	0.00	6.50	10.00	27.50	16.75	1.00	1.62
130	C		22.22	33.33	42.86	-9.52	5.00	33.33	30.56	20.50	10.00	43.50	2.50		3.00
131	C		11.11	48.81	23.81	25.00	8.00	77.78	72.22	37.50	10.00	60.50	0.25		3.25
132	R	1	33.33	95.24	76.19	19.05	8.00	86.11	86.11	53.00	10.00	70.00	0.12		3.38
133	A		33.33	11.90	14.29	-2.38	2.00	22.22	22.22	13.00	10.00	42.00	9.50		3.38
134	C		44.44	50.00	33.33	16.67	3.00	27.78	22.22	20.00	10.00	43.00	7.50		1.75
137	R		33.33	42.86	38.10	4.76	5.00	50.00	50.00	30.00	10.00	51.00	4.38		2.62

(table continues)

Appendix T (Continued)

Table 25. *(continued)*

Id[a]	T[b]	G[c]	Achievement Pre	Post	Ret	Diff[s]	Assignments N[d]	NBP[e]	BP[f]	Class Points Before[g]	E[h]	Final[i]	Procrastination Late[j]	Req[k]	Pref[l]
138	R	3	44.44	63.10	61.90	1.19	4.00	55.56	55.56	34.50	10.00	55.50	12.62		2.38
139	R		11.11	57.14	23.81	33.33	8.00	83.33	83.33	43.50	10.00	64.50	0.12		2.12
140	A		33.33	34.52	14.29	20.24	0.00	0.00	0.00	11.50	10.00	40.50	16.75		1.62
141	C		33.33	19.05	33.33	-14.29	5.00	52.78	25.00	17.00	10.00	40.00	3.62		2.50
142[m]	R		22.22	59.52	38.10	21.43	5.00	38.89	38.89	27.00	10.00	48.00	1.25		2.50
143	R		33.33	27.38	33.33	-5.95	6.00	50.00	50.00	26.50	10.00	47.50	4.00		2.50
144	A	10	22.22	42.86	33.33	9.52	8.00	69.44	69.44	34.00	10.00	63.00	0.00		2.75
145	R		11.11	16.67	9.52	7.14	3.00	33.33	33.33	19.00	10.00	40.00	8.00		3.00
146	R		33.33	16.67	9.52	7.14	0.00	0.00	0.00	7.00	10.00	28.00	16.75		3.62
147	R		33.33	29.76	23.81	5.95	4.00	33.33	33.33	21.50	10.00	42.50	8.00		3.38
148	A		$\boxed{26.65}$	75.00	71.43	3.57	8.00	83.33	63.89	41.00	5.00	65.00	3.50	2.00	3.00
149	C		44.44	89.29	71.43	17.86	6.00	72.22	52.78	38.50	10.00	61.50	6.12		2.75
150	R	3	$\boxed{26.65}$	34.52	33.33	1.19	3.00	25.00	25.00	19.00	5.00	35.00	9.38		1.75
151	A		11.11	41.67	14.29	27.38	4.00	50.00	30.56	22.50	10.00	51.50	4.88	2.00	2.12
152	C		22.22	46.43	38.10	8.33	4.00	41.67	19.44	17.50	10.00	40.50	5.75		2.38
153[m]	C		33.33	34.52	33.33	1.19	5.00	27.78	11.11	12.50	10.00	35.50	3.62		2.38
155	A		33.33	15.48	9.52	5.95	0.00	0.00	0.00	6.50	10.00	35.50	16.75		2.50
157	A	8	22.22	44.05	38.10	5.95	8.00	63.89	63.89	32.50	10.00	61.50	-0.38		2.88
159	C		11.11	55.95	38.10	17.86	5.00	47.22	27.78	23.00	10.00	46.00	2.62	2.00	2.00
160	A	8	33.33	11.90	9.52	2.38	2.00	22.22	22.22	13.00	10.00	42.00	9.25		2.50
162	R		33.33	16.67	19.05	-2.38	0.00	0.00	0.00	7.00	10.00	28.00	16.75		2.62
163	A	10	22.22	40.48	28.57	11.90	4.00	44.44	44.44	27.00	10.00	56.00	3.88		2.38
164	A	8	11.11	66.67	47.62	19.05	8.00	75.00	58.33	35.50	10.00	64.50	2.62		3.25
165	R	19	33.33	38.10	23.81	14.29	5.00	52.78	52.78	30.50	10.00	51.50	14.38		2.62
166	C		22.22	73.81	57.14	16.67	8.00	77.78	80.56	48.00	10.00	70.00	-1.75		3.25
167	A	9	$\boxed{26.65}$	38.10	33.33	4.76	5.00	50.00	47.22	25.50	5.00	49.50	3.88		3.88
168	R		33.33	$\boxed{32.69}$	14.29	18.40	8.00	58.33	58.33	21.00	5.00	37.00	11.50		$\boxed{2.79}$
169	R		22.22	$\boxed{30.44}$	19.05	11.39	8.00	36.11	36.11	13.00	5.00	29.00	13.75		$\boxed{2.79}$
172	A		44.44	52.38	38.10	14.29	0.00	0.00	0.00	11.50	10.00	40.50	16.75		2.12
173	C		33.33	44.05	19.05	25.00	4.00	52.78	27.78	22.50	10.00	45.50	5.25	2.00	3.62
174[o]	C		22.22	45.24	38.10	7.14	8.00	86.11	75.00	38.50	10.00	61.50	0.00	2.00	2.25
175	C	14	11.11	26.19	23.81	2.38	8.00	83.33	55.56	28.00	10.00	51.00	3.25	2.00	2.00

(table continues)

Table 25. *(continued)*

Id[a]	T[b]	G[c]	Achievement				Assignments			Class Points			Procrastination		
			Pre	Post	Ret	Diff[s]	N[d]	NBP[e]	BP[f]	Before[g]	E[h]	Final[i]	Late[j]	Req[k]	Pref[l]
176	C		33.33	15.48	19.05	-3.57	4.00	47.22	50.00	24.50	10.00	47.50	3.00		2.12
177	A		22.22	92.86	71.43	21.43	8.00	100.00	100.00	57.00	10.00	70.00	-0.25		2.25
178	R		11.11	32.14	19.05	13.10	4.00	11.11	11.11	13.00	10.00	34.00	5.75		1.88
179	R		11.11	39.29	14.29	25.00	5.00	52.78	47.22	29.00	10.00	50.00	5.50		4.00
180	C	14	55.56	45.24	28.57	16.67	8.00	94.44	72.22	39.00	10.00	62.00	0.38		2.50
182	A		22.22	$\boxed{21.54}$	4.76	16.78	4.00	55.56	22.22	8.00	5.00	32.00	8.75		$\boxed{2.79}$
183	C	16	11.11	90.48	95.24	-4.76	8.00	97.22	100.00	56.00	10.00	70.00	-1.88		3.38
184	A		22.22	57.14	23.81	33.33	8.00	86.11	86.11	44.50	10.00	70.00	-1.25		3.38
185	C	18	33.33	48.81	52.38	-3.57	8.00	100.00	100.00	47.50	10.00	70.00	-0.38		2.62
186	C	16	11.11	86.90	57.14	29.76	8.00	97.22	86.11	51.00	10.00	70.00	-0.12		3.38
187	A		22.22	10.71	4.76	5.95	5.00	55.56	0.00	4.50	10.00	33.50	16.12		2.25
188	A		33.33	34.52	47.62	-13.10	2.00	22.22	22.22	16.50	10.00	45.50	9.50		1.88
190[m]	A		33.33	42.86	38.10	4.76	7.00	55.56	13.89	17.00	10.00	46.00	5.12		2.62
191[m]	C		33.33	16.67	19.05	-2.38	6.00	58.33	30.56	18.00	10.00	41.00	5.00		3.75
192	R		22.22	67.86	52.38	15.48	8.00	86.11	52.78	35.50	10.00	56.50	15.75		3.00
193	A	7	33.33	39.29	47.62	-8.33	4.00	52.78	11.11	14.50	10.00	43.50	6.12		2.62
194	R	4	33.33	26.19	23.81	2.38	4.00	55.56	55.56	28.00	10.00	49.00	8.12		2.62
195[m]	C		33.33	13.10	14.29	-1.19	2.00	22.22	8.33	8.50	10.00	31.50	11.25		3.62
196	C		11.11	65.48	71.43	-5.95	8.00	100.00	100.00	50.00	10.00	70.00	-1.25		3.12
197	A	9	0.00	27.38	19.05	8.33	5.00	58.33	30.56	18.00	10.00	47.00	5.62		2.75
198	R		55.56	40.48	14.29	26.19	8.00	88.89	88.89	41.50	10.00	62.50	2.75		2.62
199	R		22.22	$\boxed{36.06}$	19.05	17.01	5.00	47.22	47.22	17.00	5.00	33.00	8.50		$\boxed{2.79}$
200	R		33.33	$\boxed{17.61}$	14.29	3.32	2.00	22.22	22.22	8.00	5.00	24.00	9.50		$\boxed{2.79}$
201	R		11.11	65.48	52.38	13.10	8.00	94.44	94.44	49.50	10.00	70.00	2.12		2.88
202	C		22.22	25.00	9.52	15.48	6.00	52.78	0.00	10.50	10.00	33.50	10.00		4.00
203	A		11.11	$\boxed{87.2}$	71.43	15.77	8.00	100.00	77.78	28.00	5.00	52.00	0.25		$\boxed{2.79}$
204[m]	R		0.00	21.43	4.76	16.67	0.00	0.00	0.00	6.00	10.00	27.00	16.75		2.12
205	C		44.44	30.95	28.57	2.38	5.00	41.67	8.33	13.00	10.00	36.00	6.38		3.50
206	R		22.22	38.10	23.81	14.29	0.00	0.00	0.00	10.00	10.00	31.00	16.75		1.50
207	C	13	22.22	65.48	52.38	13.10	6.00	58.33	19.44	22.50	10.00	45.50	4.50		3.25
208	A		22.22	64.29	66.67	-2.38	8.00	63.89	22.22	23.00	10.00	52.00	1.75		2.38
209	C		33.33	27.38	33.33	-5.95	8.00	52.78	58.33	31.00	10.00	54.00	-2.50		2.62

(table continues)

Table 25. *(continued)*

Id[a]	T[b]	G[c]	Achievement				Assignments			Class Points			Procrastination		
			Pre	Post	Ret	Diff[s]	N[d]	NBP[e]	BP[f]	Before[g]	E[h]	Final[i]	Late[j]	Req[k]	Pref[l]
210	A		11.11	16.67	14.29	2.38	5.00	55.56	0.00	7.00	10.00	36.00	16.12		2.12
213	A		33.33	17.86	14.29	3.57	3.00	22.22	2.78	8.50	10.00	37.50	7.88		3.62
214	C		33.33	52.38	66.67	-14.29	8.00	44.44	44.44	29.00	10.00	52.00	-1.12		3.12
215	R		55.56	20.24	14.29	5.95	3.00	33.33	33.33	19.00	10.00	40.00	8.50		2.25
216	R	4	33.33	88.10	66.67	21.43	8.00	88.89	88.89	52.50	10.00	70.00	5.75		3.00
217	R		11.11	20.24	4.76	15.48	6.00	69.44	63.89	31.50	10.00	52.50	11.88		2.38
219[p]	R	3	33.33	$\boxed{0}$	0.00	0.00	0.00	0.00	0.00	0.00	5.00	16.00	16.75		$\boxed{2.79}$
223	R	19	22.22	30.95	28.57	2.38	4.00	52.78	52.78	29.00	10.00	50.00	9.38		2.75
225	A	11	33.33	66.67	57.14	9.52	8.00	97.22	75.00	44.50	10.00	70.00	3.50		3.38
226	C		11.11	$\boxed{21.85}$	9.52	12.33	0.00	0.00	0.00	0.00	5.00	18.00	16.75		$\boxed{2.79}$
227	C		0.00	22.62	38.10	-15.48	4.00	55.56	33.33	20.00	10.00	43.00	5.50		2.25
228[m]	R		11.11	58.33	47.62	10.71	4.00	2.78	2.78	13.50	10.00	34.50	16.12		2.75
229	C	17	33.33	64.29	66.67	-2.38	7.00	55.56	55.56	33.50	10.00	56.50	0.00		3.25
230	R	3	44.44	63.10	47.62	15.48	7.00	58.33	58.33	37.00	10.00	58.00	8.88		2.50
231[m]	C	13	11.11	47.62	9.52	38.10	4.00	50.00	38.89	25.00	10.00	48.00	4.50		3.88
233	A		22.22	45.24	33.33	11.90	4.00	36.11	8.33	14.50	10.00	43.50	8.00		3.38
236	A		33.33	$\boxed{13.78}$	9.52	4.26	0.00	0.00	0.00	0.00	5.00	24.00	16.75		$\boxed{2.79}$
237	R	3	22.22	$\boxed{36.36}$	14.29	22.07	0.00	0.00	0.00	0.00	5.00	16.00	16.75		$\boxed{2.79}$
238	C	17	33.33	38.10	23.81	14.29	8.00	80.56	80.56	39.00	10.00	62.00	0.00		1.88
239	C		33.33	52.38	47.62	4.76	8.00	80.56	58.33	34.00	10.00	57.00	0.25		2.12
240	R	5	22.22	$\boxed{22.38}$	9.52	12.86	7.00	86.11	75.00	27.00	5.00	43.00	8.12		$\boxed{2.79}$
242[m]	A		33.33	20.24	23.81	-3.57	5.00	55.56	27.78	18.50	10.00	47.50	6.62		2.88
243	R		22.22	34.52	23.81	10.71	7.00	63.89	63.89	31.50	10.00	52.50	4.75		1.88
244	R		22.22	79.76	76.19	3.57	8.00	100.00	100.00	54.50	10.00	70.00	-0.50		2.50
245[m]	C		44.44	21.43	9.52	11.90	0.00	0.00	0.00	7.50	10.00	30.50	16.75		3.25
247[m]	A	8	22.22	15.48	23.81	-8.33	3.00	33.33	33.33	18.50	10.00	47.50	6.50		1.62
248	A	12	22.22	21.43	14.29	7.14	4.00	36.11	36.11	22.00	10.00	51.00	6.25		3.38
250	R		22.22	35.71	23.81	11.90	0.00	0.00	0.00	10.50	10.00	31.50	16.75		2.62
251	R	6	33.33	10.71	9.52	1.19	0.00	0.00	0.00	4.50	10.00	25.50	16.75		3.00
252[m]	R	6	55.56	9.52	9.52	0.00	0.00	0.00	0.00	4.00	10.00	25.00	16.75		2.75
253	C		44.44	51.19	38.10	13.10	7.00	52.78	30.56	25.00	10.00	48.00	3.62		3.00
254	A	10	22.22	57.14	14.29	42.86	8.00	94.44	94.44	47.50	10.00	70.00	-0.25		2.12

(table continues)

Table 25. *(continued)*

Id[a]	T[b]	G[c]	Achievement				Assignments			Class Points			Procrastination		
			Pre	Post	Ret	Diff[s]	N[d]	NBP[e]	BP[f]	Before[g]	E[h]	Final[i]	Late[j]	Req[k]	Pref[l]
255	A		11.11	55.95	52.38	3.57	7.00	69.44	50.00	31.00	10.00	60.00	0.38		2.50
256	C		22.22	98.81	66.67	32.14	8.00	100.00	111.11	63.50	10.00	70.00	-5.75		4.12
257	C	18	22.22	51.19	33.33	17.86	8.00	86.11	80.56	41.50	10.00	64.50	-0.38		2.88
258	C		44.44	86.90	71.43	15.48	7.00	80.56	55.56	40.00	10.00	63.00	4.88		1.88
259	R		22.22	72.62	42.86	29.76	6.00	72.22	72.22	41.50	10.00	62.50	11.25		2.50
261	R		55.56	92.86	95.24	-2.38	8.00	86.11	86.11	53.50	10.00	70.00	-5.00		3.50
262	A		33.33	44.05	38.10	5.95	8.00	94.44	94.44	45.00	10.00	70.00	-0.62		3.75
263	C		33.33	80.95	66.67	14.29	8.00	100.00	100.00	55.00	10.00	70.00	-0.50		2.75
264	A	12	33.33	19.05	28.57	-9.52	3.00	27.78	27.78	16.50	10.00	45.50	9.38		2.88
265	C		22.22	$\boxed{11.16}$	4.76	6.40	7.00	72.22	5.56	2.00	5.00	20.00	9.62		$\boxed{2.79}$
266[m]	C		44.44	25.00	38.10	-13.10	4.00	52.78	25.00	16.50	10.00	39.50	6.25		3.62
267	R		55.56	35.71	28.57	7.14	8.00	88.89	88.89	41.00	10.00	62.00	0.00		2.00
268	A		11.11	16.67	9.52	7.14	0.00	0.00	0.00	7.00	10.00	36.00	16.75		3.00
269	R		44.44	82.14	57.14	25.00	8.00	97.22	97.22	54.50	10.00	70.00	0.25		4.50
270	A		22.22	69.05	57.14	11.90	8.00	75.00	52.78	36.00	10.00	65.00	0.75		3.25
271	R		33.33	85.71	80.95	4.76	8.00	100.00	100.00	57.00	10.00	70.00	15.75		4.25
272[m]	A		11.11	15.48	$\boxed{8.31}$	7.17	4.00	30.56	0.00	5.00	10.00	34.00	8.38		4.50
274	C		22.22	51.19	52.38	-1.19	8.00	94.44	94.44	48.00	10.00	70.00	-0.62		3.00
275	A	11	44.44	21.43	23.81	-2.38	8.00	63.89	11.11	11.50	10.00	40.50	10.25		3.25
279	R		33.33	89.29	61.90	27.38	8.00	94.44	94.44	55.00	10.00	70.00	-0.12		2.50
280	C		22.22	27.38	14.29	13.10	0.00	0.00	0.00	7.00	10.00	30.00	16.75		2.88
281	A		33.33	19.05	9.52	9.52	5.00	58.33	50.00	26.00	10.00	55.00	2.25		2.88
282	R		22.22	66.67	57.14	9.52	6.00	69.44	63.89	37.50	10.00	58.50	13.00		3.00
283	A		33.33	27.38	$\boxed{30.19}$	-2.81	0.00	0.00	0.00	7.00	10.00	36.00	16.75		3.38
284	C		33.33	52.38	47.62	4.76	7.00	63.89	44.44	29.00	10.00	52.00	0.62		1.75
285	C		44.44	50.00	33.33	16.67	8.00	86.11	83.33	43.50	10.00	66.50	0.25		2.50
286	R	3	22.22	9.52	14.29	-4.76	6.00	63.89	63.89	27.00	10.00	48.00	7.88		2.25
287	C	14	11.11	45.24	42.86	2.38	8.00	69.44	55.56	31.50	10.00	54.50	0.12		2.75
288[q]	A		44.44	66.67	19.05	47.62	6.00	50.00	30.56	25.50	10.00	54.50	0.75	2.00	1.88
290	C		55.56	19.05	19.05	0.00	0.00	0.00	0.00	6.50	10.00	29.50	16.75		2.25
291	R		0.00	59.52	19.05	40.48	7.00	66.67	66.67	35.50	10.00	56.50	1.50		3.50
292	C		11.11	35.71	14.29	21.43	8.00	94.44	88.89	42.50	10.00	65.50	-0.25		3.00

(table continues)

Appendix T (Continued)

Table 25. *(continued)*

Id[a]	T[b]	G[c]	Achievement				Assignments			Class Points			Procrastination		
			Pre	Post	Ret	Diff[s]	N[d]	NBP[e]	BP[f]	Before[g]	E[h]	Final[i]	Late[j]	Req[k]	Pref[l]
293	R		33.33	$\boxed{38.6}$	14.29	24.31	0.00	0.00	0.00	0.00	5.00	16.00	16.75	4.00	$\boxed{2.79}$
G1	R	1	27.78	88.69	66.67	22.02	7.00	66.67	66.67	44.75	10.00	63.75	3.81		3.06
G3	R	3	$\boxed{32.22}$	$\boxed{34.43}$	28.57	5.86	3.33	33.80	33.80	19.58	7.50	38.08	12.04		$\boxed{2.41}$
G4	R	4	33.33	57.14	45.24	11.90	6.00	72.22	72.22	40.25	10.00	59.50	6.94		2.81
G5	R	5	16.67	$\boxed{34.40}$	23.81	10.59	7.00	80.56	72.22	32.00	7.50	50.50	7.88		$\boxed{2.90}$
G6	R	6	44.44	10.12	9.52	0.60	0.00	0.00	0.00	4.25	10.00	25.25	16.75		2.88
G7	A	7	33.33	50.00	47.62	2.38	6.00	36.11	15.28	17.50	10.00	46.50	2.88		2.69
G8	A	8	22.22	34.52	29.76	4.76	5.25	48.61	44.44	24.88	10.00	53.88	4.50		2.56
G9	A	9	$\boxed{13.32}$	32.74	26.19	6.55	5.00	54.17	38.89	21.75	7.50	48.25	4.75		3.31
G10	A	10	22.22	46.83	25.40	21.43	6.67	69.44	69.44	36.17	10.00	63.00	1.21		2.42
G11	A	11	38.89	44.05	40.48	3.57	8.00	80.56	43.06	28.00	10.00	55.25	6.88		3.31
G12	A	12	27.78	20.24	21.43	-1.19	3.50	31.94	31.94	19.25	10.00	48.25	7.81		3.12
G13	C	13	16.67	56.55	30.95	25.60	5.00	54.17	29.17	23.75	10.00	46.75	4.50		3.38
G14	C	14	25.93	38.89	31.75	7.14	8.00	82.41	61.11	32.83	10.00	55.83	1.25	0.67	2.42
G14[r]	C	14	25.00	40.48	33.33	7.14	8.00	83.33	64.58	34.25	10.00	57.25	0.94	1.00	2.38
G15	C	15	33.33	59.52	61.90	-2.38	8.00	69.44	61.11	35.00	10.00	58.00	0.75		2.75
G16	C	16	11.11	88.69	76.19	12.50	8.00	97.22	93.06	53.50	10.00	70.00	-1.00		3.38
G17	C	17	33.33	51.19	45.24	5.95	7.50	68.06	68.06	36.25	10.00	59.25	0.00		2.56
G18	C	18	27.78	50.00	42.86	7.14	8.00	93.06	90.28	44.50	10.00	67.25	-0.38		2.75
G19	R	19	27.78	34.52	26.19	8.33	4.50	52.78	52.78	29.75	10.00	50.75	11.88		2.69
G30	A	30	16.67	13.69	9.52	4.17	5.00	55.56	0.00	5.75	10.00	34.75	16.12		2.19
G31	R	31	22.22	41.07	26.19	14.88	5.00	51.39	48.61	29.50	10.00	50.50	4.94		3.31

(table continues)

Table 25. *(continued)*

			Achievement				Assignments			Class Points			Procrastination		
Id[a]	T[b]	G[c]	Pre	Post	Ret	Diff[s]	N[d]	NBP[e]	BP[f]	Before[g]	E[h]	Final[i]	Late[j]	Req[k]	Pref[l]
G32	C	32	33.33	43.45	50.00	-6.55	6.50	36.11	27.78	20.75	10.00	43.75	1.25		2.75
G33	R	33	22.22	36.90	23.81	13.10	0.00	0.00	0.00	10.25	10.00	31.25	16.75		2.06

Note. Values in boxes indicate missing data for which values were estimated in whole or in part. Scores for individuals in groups were analyzed via group averages.

[a]Student identification number. Numbers beginning with G indicate student-made groups. Groups G1-G19 were identified prior to treatment, and G30-G33 emerged during treatment. [b]Treatment. [c]Student-made study group. Values in [1,19] indicate groups identified prior to the treatment condition. Values in [30,33] indicate groups identified after the treatment condition. [d]Number of assignments completed out of eight. [e]Assignment grade before application of bonus and penalty points. [f]Assignment grade after application of bonus and penalty points. [g]HTML grade earned toward EdTech before applying curve and extra credit. [h]Extra credit earned for completing the pretest and/or pacing preference survey (five points each). [i]HTML grade earned toward EdTech after applying extra credit points and a curve. To equalize differences in mean grades, students received different curves depending on treatment, with 11 points for students in R, 13 for students in C, and 19 for students in A. [j]Average level of procrastination on each assignment in terms of days early (negative values) or late (positive values). [k]Number of requests for deadline extensions. [l]Self-report of pacing preference with values in the range [1,5] and higher values indicating a higher preference for student-pacing. [m]Reported completing a larger number of assignments alone than actually submitted for grading. [n]Took posttest and pacing preference survey after retention test, so data treated as missing. [o]Not identified in group 14 prior to study, but identified afterwards and included in group 26. Student was included in group 14 for analysis of preference data only. [p]Converted -6.12 to 0 for imputed posttest score. [q]Difference score is an outlier with $z = 3.35$. [r]Averages include values from student #174 and were used for analysis of preference data only. [s]Posttest score minus retention test score.

Appendix U
Contents of CD-ROM

The CD-ROM accompanying the dissertation includes a copy of each of the four courseware versions used in the study. Three versions, 1.2r, 1.2c, and 1.2a, were delivered to the students, depending on the treatment condition to which they were assigned. The fourth version, 1.2, was utilized by the course officials. The only difference between the student versions was the discussion of deadlines. The teacher version allowed users to select the treatment condition and to review the language presented to all students. The student versions had specific links allowing them to contact course officials easily. The teacher version provided tools for logging deadline extension requests and for grading submissions as well as a list of all students and the treatments to which they were assigned. Version 1.4 of the courseware is also included on the CD-ROM. Study specific information, including exact deadlines, has been removed or altered, so that the courseware may be utilized by a more general audience. Version 1.4 incorporates improvements which allow the user to turn off the sound, to view the courseware on a Windows 98 PC using either Internet Explorer 5 or Netscape Navigator 6.1, and to hear the narrations using QuickTime Player 5.0.2. It also includes an updated index and copyright information as well as narration corrections and display enhancements.

The CD-ROM also contains information on the assignments completed by the students, including working product versions, solution code, and grading rubrics. In addition, the complete dissertation is accessible in PDF format, and the defense may be reviewed in whole or in part. It consists of one video segment presented in MOV format and numerous audio segments presented in MP3 format. The raw data in Appendix T are provided in a format which is easy to access via an analysis program such as SAS. Finally, source code for conducting the randomization tests (C) and more traditional analyses (SAS) as well as for generating the graphs (gnuplot) in the dissertation are provided.

About the Author

Tina Laree Majchrzak received the following degrees from the University of South Florida: Bachelor of Arts, Magna Cum Laude, in Mathematics with Religious Studies minor (1991); Master of Science in Computer Science (1995), and Doctor of Philosophy in Curriculum and Instruction with emphasis in Instructional Technology (2001). She received four scholarships and fellowships and worked as a research assistant, a teaching assistant, and an Internet programmer. During the past ten years, she has taught undergraduates and gifted middle and high school students Mathematics and computer programming. Mrs. Majchrzak was awarded the Provost's Commendation for Outstanding Teaching By A Graduate Student. She published three conference papers, one of which was later included in a book, one journal article, three symposium reports, and three tutorials on HTML, JavaScript, and C programming. She also collaborated with the Florida Center for Instructional Technology on a computer networking tutorial and an FCAT tool for Teachers.