

## **The Effects of Three Web-Based Delivery Models on Undergraduate College Student Achievement**

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Web-based instruction (WBI) is becoming much more common with the growth of the Internet and available computer networks (Harasim, Hiltz, Teles, & Turoff, 1995). With the rapid expansion of WBI there is a need to examine its effectiveness. This quasi-experimental study compared three delivery models: direct instruction, concept attainment, and small-group discussion. The study found no significant main effects. However, there was a significant interaction effect between delivery model and prior web experience. This indicates that for some learners, certain delivery models may be more effective for web-based environments.

As the United States moves from an industrial to an information economy, the need for technically literate employees is growing rapidly. Public education is under increased scrutiny and is being criticized by business and industry for being slow moving and overly conservative, particularly when implementing new technologies and innovations (Perelman, 1994).

The computer has been promoted as the primary vehicle to achieve this paradigm shift. Anytime and anyplace instruction has been widely viewed as a replacement for schools and teachers. Some pundits have even suggested that traditional classroom instruction will become unnecessary as computers become less expensive and more ubiquitous (Perelman, 1994). On the other hand, Fraser (1999) observed that the current use of computer technology is simply “translation and redistribution; new access to fundamentally old stuff... The Web merely changes access, not pedagogy” (p.1). Addressing the possible paradigm shift, Fraser asked, “Surely there is something more to this revolution” (p.1). Further, Ahern (1996) suggested that designers need to “choose the most appropriate technologies for a particular instructional task” (p.23). More research on nontraditional delivery methods is necessary to determine the best task-to-technology fit.

Web-based instruction (WBI) is becoming much more common with the growth of computer networks (Harasim, Hiltz, Teles, & Turoff, 1995). The rapid expansion of WBI necessitates examining its effectiveness because instruction is more than simply displaying information. Instruction requires an integrated fit that considers the content, the current state of the learner and the delivery model to achieve success.

Delivery models are approaches to instruction with an underlying theoretical framework designed to bring about a particular type of learning (Joyce & Weil, 2000). Joyce and Weil group the various models into “families” based on the learning theories from which the models were derived. In this study we were interested in three families: behavioral, information processing and social interaction. Personal models are not discussed as they are beyond the scope of this article.

## BEHAVIORAL DELIVERY MODELS

Based on the work of Skinner (1938), behavioral models take advantage of the human ability to modify behavior in response to stimulus and feedback. This family of instructional models is used in a wide variety of applications, from teaching information to changing habits, decreasing phobias, and learning to control one’s own behavior.

One important application of behavioral systems theory is in the development of instruction. Behavioral delivery systems enable learning tasks to be regulated according to the progress of the learners. This allows students to pace themselves for optimal performance. Often these systems organize material to be learned into small sequenced instructional modules that are

presented to the students with assessments of learning embedded in them (Joyce & Weil, 2000). Some of these behavioral delivery models include mastery learning, direct instruction, contingency management, and self-training through simulation.

The direct instruction model can be traced back to the work of Thorndike (1913), and was systematically developed by Skinner (1958) as programmed instruction. The direct instruction model involves sequencing the content into small modules. The model first presents a portion of the content in sequence and then reinforces its acquisition through practice. The student must demonstrate adequate performance before moving onto the next module. This approach to instruction is often characterized as linear.

### INFORMATION PROCESSING DELIVERY MODELS

In contrast to the behavioral delivery models, information processing models are concerned with how humans acquire, process, and recall information. The aim of these models is to create effective environments for the processing of information. They are designed to increase students' ability to seek and master information, organize it, build and test hypotheses, and make application to the world around them (Pressley, 1995).

Some of these models induce the students to collect information and build concepts. Others teach them to profit from direct instruction through readings, lectures, and instructional systems. Some of the information processing models include inductive thinking, concept attainment, memorization, advance organizers, and inquiry training (Joyce & Weil, 2000). Significantly, the concept attainment model provides an inductive approach to teaching, moving from the concrete to the definition of an abstract rule. The model requires students to compare and contrast exemplars that contain characteristics (called "attributes") of the concept with exemplars that do not contain those attributes.

Learning by concept attainment involves two phases. First the concept name is presented along with labeled examples of positive and negative exemplars. The learner integrates these exemplars and generates a hypothesis about the concept definition. The student then states a possible definition in terms of essential attributes. In the second phase the student identifies additional unlabeled examples as positive or negative exemplars of the concept. The student's hypothesis and definition is either confirmed or corrected, and a correct definition of the concept is given. The student then generates more concept examples. By following this model, the student learns the concepts related to the instructional content (Joyce & Weil, 2000).

## SOCIAL DELIVERY MODELS

Social delivery models attempt to capitalize on human nature to enable learning by working collaboratively in small groups (Joyce & Weil, 2000). The models range from the simple small group to more elaborate models that teach democratic social organization and the analysis of social problems and values. Social models of instructional delivery are constructed to take advantage of the “synergy” phenomenon—the collective energy generated by group work. Cooperative learning organizes students to help one another respond to the tasks presented to them.

Learning environments in which students work in pairs or larger groups, tutor each other, and share rewards are characterized by greater mastery of material than the common individual-study and recitation pattern (Johnson & Johnson, 1996). Also, the shared responsibility and interaction produce more positive feelings toward tasks and others, generate better inter-group relations, and result in better self-images for students with histories of poor achievement. The results generally affirm the assumptions that underlie the use of cooperative learning methods (Sharan, 1990).

Many developers of social delivery models believe that teacher-dominated recitation is actually counter-productive for individuals and society by depressing learning rates, creating an unnatural and even antisocial climate, and/or failing to provide opportunities for learners to maximize their potential through cooperation (Joyce & Weil, 2000). Social delivery models include partners in learning (dyads), cooperative learning, role playing, and jurisprudential inquiry (Joyce & Weil, 2000, Johnson, 1984). The evidence is largely affirmative that cooperative groups do result in improved learning (Sharan, 1990).

Beyond the traditional face-to-face instructional situations, the effectiveness of group discussion and collaboration has been shown to be effective in distance education (Harasim et al., 1995). Specialized computer network software such as the *IdeaWeb* (Ahern, 2000) can be used for group discussion and collaboration in online environments as a form of computer-mediated communication (CMC). The *IdeaWeb* represents an opportunity to use the strengths of the Web to create a collaborative learning environment within WBI.

With Internet delivery there are many cooperative learner approaches for effective instructional environments. These include online mentoring, tutor support, informal peer interaction, and expert forums. Online group learning structures include online seminars, small group discussions, learning partnerships and dyads, learning circles, and teaching and presentations

by the learners. Role playing simulations, online debates, and informal chat areas are also viable instructional environments (Harasim et al., 1995).

### NETWORKING AND INSTRUCTIONAL DESIGN

Computer networks offer new opportunities for instruction. The widespread proliferation of personal computers and the growth of the Internet have made WBI a viable instructional delivery method. Internet-based courses are being offered as an alternative to traditional face-to-face instruction. The ubiquity of the Web has led to a large expansion of online course offerings in higher education. In the United States, the American Open University, Nova Southeastern University, and the University of Phoenix have been leaders in providing distance education. Now the more traditional universities are offering dozens of courses and even entire degrees online (Lintz & Tognotti, 1996). The Internet overcomes some of the constraints of other media, in that users can interact in real time and or asynchronously at their convenience.

Even though the Web affords the opportunity for dynamic instruction, many web-based courses rely on the direct instruction model. As commonly used, this model does not take advantage of the available attributes of the Web. These attributes include the availability of asynchronous interaction and discussion with the instructor or classmates. Another important attribute is hypertext linking between related topics, mirroring information-processing ideas about human cognition. In addition, there are protocols and software tools such as LISTSERV's, chat, e-mail, and newsgroups that allow various modes of interaction, such as one-to-one, one-to-many, and many-to-many (Harasim, 1990).

Behavioral delivery models may be perceived to present low instructor demands in terms of time and design expertise. This perception may stem from Skinner's advocacy of teaching machines and instructor-proof delivery of instruction (Skinner, 1958). Models such as direct instruction and mastery learning are conveniently translated into online study guides that lead the learner step-by-step through the instructional content. Often these materials are organized into instructional modules, which can be easily assessed in terms of student achievement (Price, 1996).

To realize the potential inherent in the Internet, other delivery models should be investigated, particularly as universities and businesses embark upon major distance education initiatives. Instructional models from the information processing and social interaction families may not necessarily require greater instructor time or resources to implement. Modified design

and specialized software present an opportunity to use these models in non-traditional instruction. Behavioral, social interaction, and information processing models should be compared in WBI environments to determine appropriateness for the instructional audience and goal.

## THE STUDY

The question addressed by this study was “how does the delivery model affect achievement of undergraduate college students in an online self-paced lesson?” Three groups were created, with each group using one delivery model from the three major families. The models employed were direct instruction, concept attainment, and small-group discussion.

### Participants

Participants in this study were 123 undergraduate college students enrolled in a self-paced campus-based computer literacy course at a large public university in the Southwestern United States. The participants represented one class section selected as an intact group from four sections of the computer literacy course. The participants represented many different colleges and majors. The participants were randomly assigned to one of three treatment groups. The research design for this study was a 2 x 3 randomized block design combining three levels of one independent variable (delivery model) with two levels of a blocking variable (prior Web experience).

### Materials

Instructional content for the three groups came from the Introduction to Computing and Technology study guide (Price, 1996). The content included information on uses of telecommunications, common definitions, Internet uses, Boolean searching, and online bibliographic databases. The design of the instruction was validated through a pilot study conducted with a similar participant sample in a previous semester. In the pilot study 150 students completed the instruction and provided feedback on design, appearance, and ease of use.

The first group followed the direct instruction (DI) model. The researcher converted the printed Study Guide material to HTML. Figure 1 illustrates the content for a DI participant.

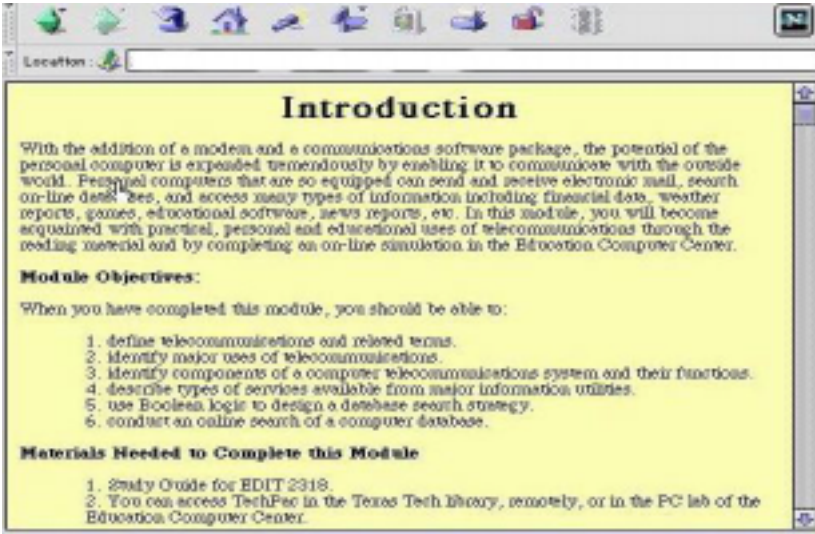


Figure 1. DI participant content

The instruction for the second group was designed following the concept attainment (CA) model of instruction. A sample of the web-based concept attainment lesson is shown in Figure 2.

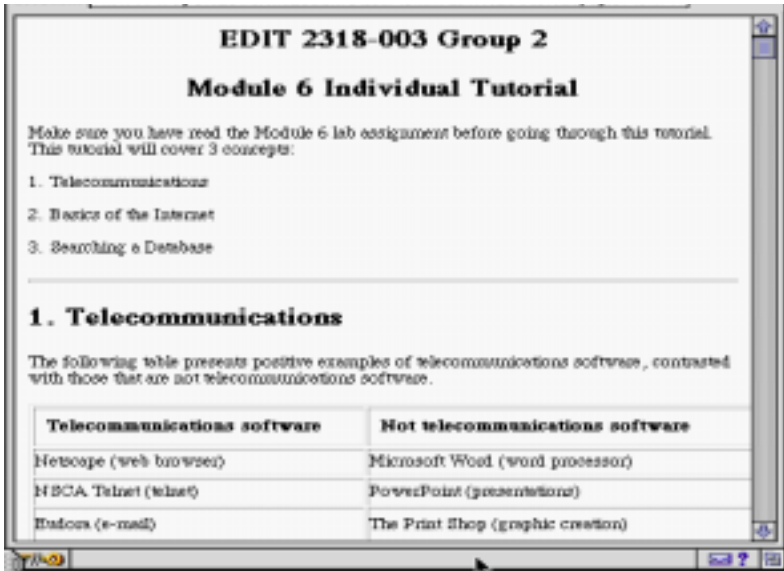
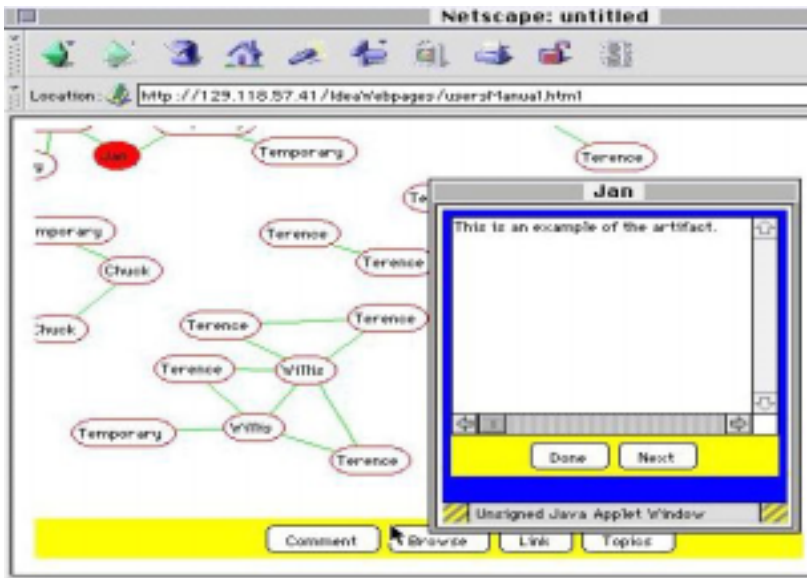


Figure 2. CA model

The third group used the group discussion model (GD) for accessing the instruction. To facilitate group discussion by way of the Web, the participants used proprietary communications software named the *IdeaWeb*. This software enables asynchronous group discussion using the Internet (Ahern, 2000). The *IdeaWeb* was designed so a group member could get a quick overview of the discussion topics without having to sort through unrelated messages. With a single click a group member can determine the focus of the topic under discussion. Once a topic is selected to explore, the member can easily move into the discussion of that topic. Figure 3 shows an *IdeaWeb* discussion and an individual message.



**Figure 3.** *IdeaWeb* discussion and message

To support the interaction potential of the discussion, the *IdeaWeb* visually maps previous messages making it simple for group members to determine from whom a message originated, for whom a message was intended, and how the message fits into a sequence of messages. Additionally, the *IdeaWeb* allows members to link individual messages to more than one message simultaneously, thus simulating the “divided illocution” that is typical in most collaborative group discussions. This is important for developing a multi-voiced sequence of interaction that supports the collective nature of group discussion (Ahern & Peck, 1992). There were six groups of five to six members involved in small group discussion.

Each of the three lessons was designed to require a minimum of instructor intervention. The DI lesson required no additional instructor input during the delivery of the instruction. Likewise the concept attainment lesson was designed as a stand-alone module. The GD lesson using the *IdeaWeb* software required the instructor only to monitor the “help” discussion area to assist students in completing the assignments. This philosophy of design was intentional to test the practical viability of the delivery models for WBI.

### Data Collection

Two instruments were used in this study. A multiple-choice test from the self-paced class was used to assess learning of the instructional material. When the participants completed the instruction using the delivery models they each completed a 15 question multiple-choice exam on the instructional material. The researcher administered the exam in a paper-and-pencil format in a controlled testing center. A panel of instructors for this course developed the exam questions, drawing them directly from the printed instructional material of the class study guide. The course instructors analyzed the questions for content validity at the beginning of each semester the course has been offered. The participants had two weeks from the time they began the module to complete the delivery model on the Web and take the multiple-choice test. At the beginning of the study each participant completed a one-page demographic questionnaire. This questionnaire was used to gather participant information such as age, grade point average, ethnicity, e-mail use, Web use, college, major, and daily computer use.

The one independent variable in this study was type of delivery model. This variable had three levels: (a) direct instruction (DI); (b) concept attainment (CA); and (c) group discussion (GD). The dependent variable was the participant’s test score (ranging from 0 to 15). The participants’ prior web experience served as a blocking variable, with a value of 1 (had prior web experience) or 0 (did not have prior web experience).

### Procedures

The research activities were conducted as part of the normal curriculum of an undergraduate self-paced campus-based course entitled, Introduction to Computing and Technology. The course itself involved the completion of

10 print-based instructional modules, with approximately 10 day's time allowed for each module completion and a test. Approximately halfway through this course the students were required to complete an instructional module on telecommunications and the Internet. The researchers selected this module to use in the study based on the timeliness of the content and the module's placement in the overall course.

Before the study began the participants completed a demographic survey. The participants were then classified into two groups based on prior experience with the Web, as measured by an individual interview. These two groups of participants were then randomly assigned to one of three delivery model groups: DI, CA, and GD.

Before beginning the self-paced module, each group of participants received identical instruction on navigating the Web with a web browser. The class web site was demonstrated, and each group was shown how to access the web page for their particular group. Each group then received separate instructions for completing the activities for their assigned group.

The DI participants read through the online version of the course manual, completed the related lab assignments, and then took the test in a controlled environment—the course-testing center. A researcher monitored the testing center and administered all the tests. The CA participants completed the instruction on telecommunications concepts, completed the lab assignments, and took the same test in the testing center.

The GD participants were shown how to use the *IdeaWeb* group discussion software, including how to read and post messages and to get help. The GD participants were then randomly assigned to small groups of six to seven participants. The GD participants were then required to participate in small group discussions by way of the *IdeaWeb* a minimum of three times during a two-week period. Each participant was required to post one message to each of the three topics and to read all the postings of the other participants in the small group. The researcher read through each small group discussion at the conclusion of each day of the study to monitor participation. The researcher answered any questions regarding use of the software and participant requirements. Upon completing the discussion and the lab assignments, the GD participants took the test in the testing center.

## Analysis

An alpha level (level of significance) of .05 was used throughout the data analyses. One-way analysis of variance (ANOVA) and analysis of covariance (ANCOVA) were used to determine any statistically significant differences in test scores.

The participants' mean age was 20.7 and mean overall GPA was 2.8 on a 4.0 scale. Ninety-one percent of the participants were between 18 and 23 years of age. They used a personal computer an average of 3.2 days per week, and 60% had a computer at home. Sixty-five percent used e-mail and 49% used the Web. The participants were 63% female and 79% Caucasian. The typical participant was a 21-year-old Caucasian female who used a computer three days per week and used e-mail and may have used the Web. Table 1 shows the participant data.

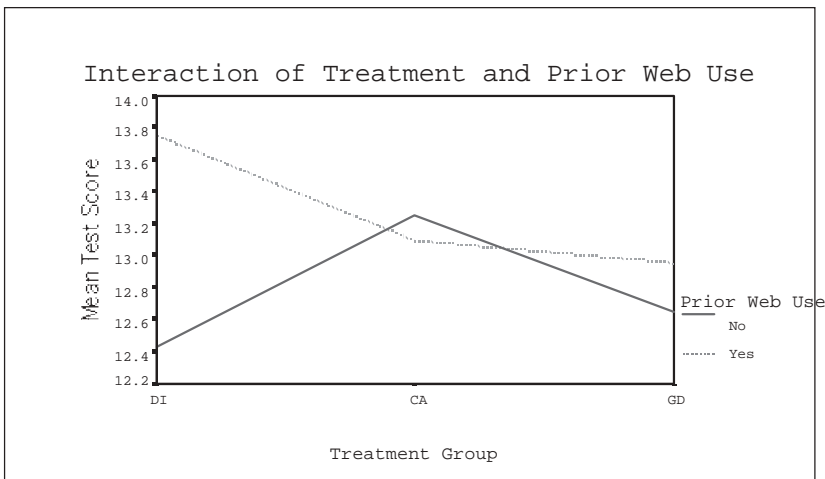
**Table 1**  
Participants by Age, Sex, and Race

<b>Age</b>	<b>n</b>	<b>Percent</b>
18	10	7.8
19	31	24.2
20	40	31.3
21	21	16.4
22	10	7.8
23	5	3.9
24+	11	8.1
<b>Sex</b>	<b>n</b>	<b>Percent</b>
male	47	36.7
female	81	63.3
<b>Race</b>	<b>n</b>	<b>Percent</b>
white	101	78.9
Hispanic	9	7.0
black	16	12.5
Asian	2	1.6

Sample means were determined for the entire sample, and for each treatment level and cell group. Mean test scores were determined for the entire sample ( $M = 13.02$ ), DI ( $M = 13.09$ ), DI without prior web experience ( $M = 12.43$ ), DI with prior Web experience ( $M = 13.75$ ), CA ( $M = 13.19$ ), CA without prior web experience ( $M = 13.26$ ), CA with prior web experience ( $M = 13.1$ ), GD ( $M = 12.81$ ), GD without prior Web experience ( $M = 12.64$ ), and GD with prior web experience ( $M = 12.96$ ).

An analysis of variance was conducted on the dependent variable—participant's test scores. The independent variable was the treatment group and the blocking variable was prior web experience. No significant differences

were found in the dependent variable between the treatment groups,  $p = .204$ . There was also no significant difference for prior web experience,  $p = .151$ . Mean test scores were determined for participants who had prior web experience and non-web users. The web users' mean test score was 13.24, and the non-web users' mean test score was 12.81. There was a significant interaction effect between treatment group and prior web experience,  $p = .002$ . So prior web experience did interact with the treatment group to cause significant differences in mean test scores. The omega-squared value was 0.07, therefore 7% of the variance in test scores can be explained by the interaction effect of treatment group and prior web experience.



**Figure 4.** Interaction of treatment group and web use

## DISCUSSION

No statistically significant differences were found in means for the main effects (delivery model and prior web experience). This is an important finding in that success of the instruction did not decrease across delivery models, and the length of time for developing and implementing each intervention was the same. This may indicate that in some cases designers can choose among delivery models without increasing development time and resources. Direct instruction is widely used in web-based instruction. However, this finding indicates that either of the two other models might be used effectively for the participant group examined.

The researchers found a significant interaction effect between delivery model and web use. This may mean that prior web experience is an important factor in determining the effectiveness of a delivery model. Experienced web users are familiar with acquiring information from the Web. However, instruction is not simply acquiring information, but rather assumes an interaction between the student and the content. The DI group had a large difference in test scores, with those participants with prior web experience scoring higher than those without. Also, the GD group participants scored higher with prior experience, but without as large a scoring margin as the DI group. Conversely, the CA group participants actually scored slightly lower with prior web experience than those without experience. This is an interesting finding for designers of WBI. This may show that using the direct instruction delivery model may require two components of training for the instruction to be effective. Those two components are the actual instructional content accompanied by the mechanics of operating in a web environment. The same may be true for the GD group. But for the CA group, the presence or lack of web training was irrelevant in terms of learning new instructional content. The highest performing participant cell group was the DI group with prior web experience. This may be explained by the simple nature of the instructional content. The use of direct instruction may be more effective for learners who are highly familiar with fairly simple content.

The study could be attempted again with similar procedures and delivery model interventions but with the following modifications: (a) a longer intervention period; (b) a more extensive instrument for measuring achievement; (c) more concepts included in the CA intervention; and (d) a longer discussion period and more required postings for the GD intervention.

Further research should be conducted encompassing an entire semester of coursework using the three delivery models from the current study. This study only used one instructional module as the treatment period, and an expanded study should encompass the entire course. It would also be interesting to use different instructional content unrelated to technology and to further equalize the levels of computer and Internet experience among participants.

There are many other delivery models to examine in terms of effectiveness for WBI. Studies should be conducted using these models singly and in combination. It would also be interesting to examine participant variables (age, gender, prior experience, etc.) and the effectiveness of various delivery models.

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