Chapter 18

Experimental Research and the Internet

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Learning Objectives

1. Summarize in your own words the debates associated with conducting experimental comparisons on the Web.
2. Describe the identifying characteristics of Web-based experimental research.
3. Summarize in your own words how the information processing modes are integrated to define a model of human cognitive architecture.
4. Describe the identifying characteristics in Anderson’s revision of Bloom’s taxonomy of educational objectives.
5. Describe the identifying characteristics in Mayer’s cognitive theory of multimedia learning.
6. Summarize in your own words how the mind works during multimedia learning.
7. Speculate on at least one application of cognitive load theory for research on Web-based learning in your area of interest.
8. Compare the comments in Clark’s position on media effects with the findings of Bernard’s recent meta-analysis of distance education technology.
9. Replicate the “Student Checklist” from memory.

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10. Describe the independent variables in Hogg’s study, and how did she controlled for age differences.
11. In Chuo’s study, summarize in your own words the effect of the Webquest writing instruction on EFL learners’ writing performance, writing apprehension, and perception.
13. Describe the treatment conditions in Part One of Tang’s study.
15. Explain why “user interaction” was important in this research.
16. State the dependent variables in Carter’s thesis research.
17. Describe the characteristics of the treatment and control groups.
18. Demonstrate the procedure for conducting Web-based experimental research.
19. Define “experimental research.”
20. Summarize in your own words “the human side of Web-based learning.”
21. Describe the prospect of conducting research on the adoption of an innovation.
22. Describe the models and theories of conducting research on online student discussions.
23. Identify which of the three types of experimental design characterizes this Web-based educational research, pre-experimental, quasi-experimental or true experimental design. Explain why.
24. Identify the dependent variable(s) and independent variable(s) in the study.
25. Describe the purpose of the study. What is being compared in the study?
26. Describe the participants in the study.
27. Facilitation strategies and the acquisition of higher order thinking skills in Web-based learning communities: A study of theory development.

Abstract

Throughout the 1950s and 1960s experimental research played a major role in audio-visual research and development (Reiser, 1987, 2002). Experiments were published on the effects of slide-tape presentations, educational television, programmed learning, teaching machines, and audio-tutorial instruction. During the 1970s and 1980s, the experimental focus shifted from audio-visual research to instructional technology research on whole programs, such as PLATO, CAL, microworlds and Internet Hunts. It seems that today we have returned to the experimental investigations of audio-visual communication. Over the years, experimental evidence of audio-visual communication has become the basis of current models and theories, including: Baddaley’s (1992) model of working memory, Paivio’s (1986) dual coding theory, Penney’s (1989)
separate streams hypothesis, Chandler and Sweller’s (1991) split-attention theory, Mayer and Moreno’s (1998) dual processing theory of working memory, Mayer’s (1997) theory of multimedia learning, and Mann’s Structured Sound Function (SSF) Model (Mann, 1992, 1995a, 1997a), and others. This chapter will discuss these models as a platform for conducting experimental research of online teaching and learning.

Introduction

Students say to me, “I’d like to run an experiment on learning over the Internet, but how should I use the Web to conduct my experiment? Is it still possible to control the variables in a true experiment on learning through the Web?” This section is focused on conducting experimental research on online teaching and learning.

Experimental Research Characteristics

“Experimental research” is classified into three types: Pre-experimental, quasi-experimental, and true experimental (Cohen, Manion, & Morrison, 2000): There are several distinguishing characteristics to experimental research.

• An artificial situation is set up in an online laboratory, online learning environment, or a microworld.

• Value judgements are minimized.

• Unhelpful comparisons are avoided, such as “Does Medium A teach better than Medium B?”

• Unfair comparisons are avoided such as “Is a Web-based tool better than a teacher”—teacher usually wins.

Debates in Conducting Experimental Comparisons

Asking the Right Questions in Experimental Research

Have you ever read an introduction to a Web-based study that says something like, “This study will compare learning from direct instruction versus constructivist learning,” and then in the literature review labels the Web “a delivery medium”? These two opposites commonly appear in research papers. If you are describing your Web-based materials as “a constructivist learning environment,” don’t then label the Web “a delivery medium.”

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Suggestion: If you are comparing instructional methods used on the Internet, it’s sufficient to say the Web should strive to use it the same way in all treatment conditions.

Most students begin by asking themselves, “Will I focus on student performance on the Web” or “constructivism on the Web”? Most research on Web-based teaching and learning today can be placed into one of these two camps, either the performance-based tradition or the constructivist tradition. Research in the performance-based tradition emphasizes learning outcomes for students and clear technology standards in educational practice for teachers, such as those presented by the International Society for Technology in Education (ISTE) in Washington, DC. Research in the constructivist tradition however, defend the learning process itself, citing research studies that support “open learning environments” for teachers and students, with instruction on “cognitive apprenticeship,” “learning by design,” “generative learning,” “concept mapping,” “procedural facilitation,” “reciprocal teaching,” “group-supported collaborative work,” “elaborative interrogation,” “student entrapping,” and other methods.

Suggestion: Clarify your goals.

Further, the main focus of research on Web-based teaching and learning today is the application of basic features of Web-based applications into particular school lessons according to one or another of these traditions described above. This kind of research typically presents expert consensus and exercises on one of these approaches.

Suggestion: Mention a small number of student grouping strategies, and students making Web pages, and include plenty of information on student Web searching.

I listened to a doctoral dissertation defense once in which the children on one side of a classroom were encouraged to program the computer in LOGO while those on the other side of the classroom were assigned the same tasks working with paper and pencil. The result? There were no significant differences. Aside from sampling problems, the experiment was confounded by demotivating the students in the paper and pencil group, with the wonderful environment provided in Microworlds to the other children. Despite the fact that this kind of research is going on all the time, the debate in Web-based educational research continues for some of us as to whether or not this kind of comparison is a fair one: technology versus paper and pencil. Thankfully, the story has a happy ending. The methodology was changed to a qualitative instrumental case study, and the student passed here Ph.D. oral exam.

Suggestion: Make your comparisons equivalent. Ask whether there are other media or another set of media attributes that would yield similar learning gains.
For those with an interest in psychology, conducting research on the human side of Web-based learning is a definite possibility.

**Human Cognition and Multimedia Learning**

Cognitive psychology research tells us that human memory is “modal”—having three distinct memory types (modes). These are sensory memory, working memory and long term memory. Each mode has its own characteristics and limitations. These three modes are integrated to define an information processing model of human cognitive architecture.

Sensory memory deals with incoming stimuli from our senses. These are sights, sounds, smells, tastes and touches. A separate partition of sensory memory exists for each of the senses. Sensory memories extinguish extremely quickly. (About half a second for visual information, three seconds for auditory information.) In that time, we must identify, classify and assign meaning to the new information or it will be gone forever.

Long-term memory refers to the immense body of knowledge and skills that we hold in a more-or-less permanently accessible form. Once a “request” is made activation (and the “answer”) is effectively instantaneous. Knowledge and skills that are activated with extremely high regularity, such as listening and talking, may be activated “automatically” without the need for high levels of conscious attention, even though the task itself may be a complex one. For easy tasks with familiar items, the student will implement automatic (Schneider & Shiffrin, 1977) or pre-attentive (Treisman, 1986) mental processing. Pre-attentive processing can occur in parallel; that is, the student mentally processes two or more different inputs simultaneously. However on difficult or unfamiliar task items, the student must consciously control their mental processing (Schneider & Shiffrin, 1977) to focus their attention (Treisman, 1986). Under these conditions, attention focusing becomes serial; only one task is processed at a time. To engage the appropriate attentive state in the Web course, the student must self-initiate the appropriate system of information processing (Borich & Tombari, 1995). In short, they must rely on our conscious working memory.

Working memory is the part of our mind that provides our consciousness. Working memory is intimately related to where and how we direct our attention to “think about something,” or to process information. The biggest limitation of working memory is its capacity to deal with no more than about seven elements of information simultaneously (Miller, 1956). Working memory capacity may be expanded slightly by mixing the senses used to present information. That is, it is easier to attend to a body of information when some of the information is presented visually and the remainder of the information is presented auditorily than it is when all of the information is presented through a single sense (either all visually or all auditorily). If the capacity of working memory is exceeded while processing a body of information then some, if not all, of that information will be...
Figure 1 shows two scenarios of working memory under high intrinsic cognitive load engaged in a difficult or unfamiliar task. In scenario (a) the learner’s attention is maximized as he or she listens to the gist at the same time as they read the details in text. In scenario (b) the learner’s attention is split by a high extraneous cognitive load imposed by a silent online interface and too much information presented in text and graphics.

**Bloom’s Revised Taxonomy**

If you are looking for an established foundational theory in which to situate your online educational research, consider Anderson’s revision of Bloom’s taxonomy of educational objectives (Anderson et al., 2001). Their revision of the original Taxonomy is a two-dimensional framework: “Knowledge” and “Cognitive Processes.”

The Knowledge framework resembles the subcategories of the original Knowledge category. The Cognitive Processes framework resembles the six categories of the original Taxonomy with the Knowledge category named Remember, the Comprehension category named Understand, Synthesis renamed Create and made the top category, and the remaining categories changed to their verb forms: Apply, Analyze, and Evaluate. They are arranged in a hierarchical structure, but not as rigidly as in the original Taxonomy.
In combination, the Knowledge and Cognitive Process dimensions form a very useful table, the Taxonomy Table. Using the Table to classify objectives, activities, and assessments provides a clear, concise, visual representation of a particular course or unit. Once completed, the entries in the Taxonomy Table can be used to examine relative emphasis, curriculum alignment, and missed educational opportunities. Based on this examination, teachers can decide where and how to improve the planning of curriculum and the delivery of instruction.

As you may be aware, Bloom’s Taxonomy of Educational Objectives is a staple in classroom teaching, it was first published in 1956 as a scheme for classifying educational goals, objectives, and even standards of practice. The original taxonomy consisted of six categories, nearly all with subcategories, and arranged in a cumulative hierarchical framework. Achievement of the next more complex skill or ability required achievement of the prior one. The original taxonomy volume emphasized the assessment of learning with many examples of test items (largely multiple choice) provided for each category. Unlike the original taxonomy, Lorin Anderson’s revision explores curricula from three unique perspectives-cognitive psychologists (learning emphasis), curriculum specialists and teacher educators (C&I emphasis), and measurement and assessment experts (assessment emphasis). This “revisited” framework allows you to connect learning in all areas of curriculum.

**Structure of the Knowledge Dimension of the Revised Taxonomy**

1. **Factual knowledge**: The basic elements that students must know to be acquainted with a discipline or solve problems in it

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*Table 1. Cognition and knowledge taxonomy table (Credit: Gavrin & Marrs (2003))*

<table>
<thead>
<tr>
<th>The Cognitive Process Dimension (Bloom's Taxonomy)</th>
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<tbody>
<tr>
<td>The Knowledge Dimension</td>
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<tr>
<td>1. Remember</td>
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<tr>
<td>2. Understand</td>
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<td>3. Apply</td>
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<td>4. Analyze</td>
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<td>5. Evaluate</td>
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<tr>
<td>6. Create</td>
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</tbody>
</table>

A. Factual Knowledge

B. Conceptual Knowledge

C. Procedural Knowledge

D. Meta-cognitive Knowledge
• Knowledge of terminology
• Knowledge of specific details and elements

2. **Conceptual knowledge:** The interrelationships among the basic elements within a larger structure that enable them to function together
   • Knowledge of classifications and categories
   • Knowledge of principles and generalizations
   • Knowledge of theories, models, and structures

3. **Procedural knowledge:** How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods
   • Knowledge of subject-specific skills and algorithms
   • Knowledge of subject-specific techniques and methods
   • Knowledge of criteria for determining when to use appropriate procedures

4. **Meta-cognitive knowledge:** Knowledge of cognition in general as well as awareness and knowledge of one’s own cognition
   • Strategic knowledge
   • Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge
   • Self-knowledge

**Structure of the Cognitive Process Dimension of the Revised Taxonomy**

1. **Remember:** Retrieving relevant knowledge from long-term memory.
   • Recognizing
   • Recalling

2. **Understand:** Determining the meaning of instructional messages, including oral, written, and graphic communication.
   • Interpreting
   • Exemplifying
   • Classifying
   • Summarizing
   • Inferring
   • Comparing
   • Explaining

3. **Apply:** Carrying out or using a procedure in a given situation.
   • Executing
   • Implementing
4. **Analyze**: Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.
   - Differentiating
   - Organizing
   - Attributing

5. **Evaluate**: Making judgments based on criteria and standards.
   - Checking
   - Critiquing

6. **Create**: Putting elements together to form a novel, coherent whole or make an original product.
   - Generating
   - Planning
   - Producing

**Thesis Research with Bloom’s Revised Taxonomy**

In 2001, J. Twist’s Ph.D. thesis on “Identities on the Line: Articulations of On- and Off-Line Communities Among UK Youth” used Bloom’s revised taxonomy. The research presents empirical work which grounds the discourses of socially inclusive “communities” in a “global information society.” The empirical work focuses on a specific group of young people of ages 11 to 25 living in one of the most ethnically diverse and poorest boroughs of London, Newham. The thesis explores the ways in which the group construct their “online” community (Newham Young People Online) and how their identities as young people are re-produced through the interplay between their everyday and their technocultural lifeworlds. Key to the work is how the group is using and shaping ICTs and cyberspace(s), which are central to a “global information society,” in different ways: to explore creativity, to find diverse ways of self-expression, to understand “difference” and to discover other spaces of learning and education against a background of social exclusion.

**Physical vs. virtual field trip.** Bloom’s revised taxonomy was evident in Lesley Garner’s Ph.D. 2004 thesis entitled “Field Trips and Their Effect on Student Achievement In and Attitudes Toward Science: A Comparison of a Physical versus a Virtual Field Trip to the Indian River Lagoon in Florida.” The purpose of this study was to determine the effect of physical and virtual field trips on students’ achievement in estuarine ecology and their attitudes toward science. The study also assessed the effect of students’ learning styles, the interaction between group membership and learning styles, and the effect of group membership on students’ ability to answer questions at different levels of Bloom’s taxonomy. Working with a convenient sample of 67 freshmen and sophomore non-science majors, students were randomly assigned to one of two treatment groups (physical, N= 32 and virtual, n = 35). Prior to treatment, students’ learning styles were determined, students were pre-assessed on the two targeted measures, and all students attended four consecutive, in-class, 75-minute lectures on estuarine ecology and the
Indian River Lagoon (IRL). Pre-assessed data indicated no significant differences between the groups on the two dependent measures. On the weekend following the lecture series, the physical field trip group engaged in a set of predetermined activities at the IRL for two hours in the morning. Later that afternoon, the virtual field trip group participated in a two-hour virtual trip to the IRL that exactly matched the physical field trip activities. This virtual trip incorporated the CD-ROM “The Living Lagoon: An Electronic Field Trip.” Following each trip, students were post-assessed using the same pre-assessment instruments. MANCOVA results indicated no significant differences on all research factors (i.e., group membership, learning style, and group-learning style interaction). Data analysis also revealed that there was no significant effect of group membership on students’ ability to answer questions at different levels of Bloom’s taxonomy. These findings imply that educators can integrate virtual field trips that are structured in the same manner as their corresponding physical field trips without significantly impacting student achievement or attitudes.

Cognitive Theory of Multimedia Learning

Mayer and Moreno’s research on a “cognitive theory of multimedia learning” has obvious connotations for studies on listening and reading from Web-based multimedia. Figure 2 represents the cognitive theory of multimedia learning based on three ideas

Figure 2. Cognitive theory of multimedia learning (Mayer, 2002, p. 61)
about how the human mind works. The right side of the figure represents the auditory-verbal channel and the left column the visual-pictorial channel.

The cognitive theory of multimedia learning proffers three assumptions about how we learn from words and pictures: The dual channel assumption, the limited capacity assumption, and the active processing assumption, represented in Figure 3.

Concerning the dual channel assumption, Mayer and Moreno have shown experimentally that the human cognitive system consists of two distinct channels for representing and manipulating knowledge: As visual-pictorial channel and an auditory-verbal channel. Picture representations enter our cognitive system through our eyes and may be processed as pictorial representations in the visual-pictorial channel. Spoken words enter the cognitive system through our ears and may be processed as verbal representations in our auditory-verbal channel.

Regarding the limited capacity assumption, Mayer and Moreno have said that each channel in the human cognitive system has a limited capacity for holding and manipulating knowledge, consistent with previous research on human attention. When a lot of picture representations (or other visual materials) are presented at one time, our visual-pictorial channel can become overloaded. Similarly, when a lot of spoken words (and other sounds) are presented at one time, the auditory-verbal channel can become overloaded.

Concerning the active processing assumption, Mayer and Moreno have found that meaningful learning occurs when learners engage in active processing within the channels, including selecting relevant words and pictures, organizing them into coherent pictorial and verbal models, and integrating them with each other and appropriate prior knowledge. These active learning processes are more likely to occur when corresponding verbal and pictorial representations are in working memory at the same time.

### Experiments by Mayer and Moreno

Psychological experiments in multimedia learning by Rich Mayer and Roxana Moreno have had a profound influence on experimental research conducted on learning from the
Web. It began in 1997 with Mayer’s article in Educational Psychologist. The paper posed and answered five questions critical to doing experimental research on learning from the Web. Mayer’s first question was on media effects “Is One Medium Better than Another?” This question is concerned with the presentation format used to present the instruction to the student, such as a book medium versus a computer medium.

In multimedia learning, is watching an online narration more effective than reading online text? How should verbal information be presented to students to enhance learning from animations: auditorily as speech or visually as on-screen text? In order to answer this question, Mayer and Moreno (1998) asked students to view an animation depicting the process of lightning either along with concurrent narration (Group AN) or along with concurrent on-screen text (Group AT).

In considering ideas for an experiment, consider Mayer’s other multimedia principles:

- **Modality Principle**: Students learn better when the verbal information is presented auditorily as speech rather than visually as on-screen text both for concurrent and sequential presentations. Why do students learn better when verbal information is presented auditorily as speech rather than visually as on-screen text? Mayer and Moreno’s (1998) study showed that students who learn with concurrent narration and animations outperform those who learn with concurrent on-screen text and animations. However, concurrent multimedia presentations force the text groups to hold material from one source of information (verbal or non-verbal) in working memory before attending to the other source. Therefore, the narration group might have had the advantage of being able to attend to both sources simultaneously, and the superior performance might disappear by using sequential multimedia presentations, where verbal and non-verbal materials are presented one after the other.

- **Redundancy principle**: Students learn better from animation and narration than from animation, narration, and text if the visual information is presented simultaneously to the verbal information.

- **Split-attention principle**: Students learn better when the instructional material does not require them to split their attention between multiple sources of mutually referring information.

- **Spatial contiguity principle**: Students learn better when on-screen text and visual materials are physically integrated rather than separated.

- **Temporal contiguity principle**: Students learn better when verbal and visual materials are temporally synchronized rather than separated in time.

- **Coherence principle**: Students learn better when extraneous material is excluded rather than included in multimedia explanations.

**Suggestion**: Consider Mayer’s questions before conducting experimental research on learning from the Web.
Cognitive Load Theory: The New Kid on the Block

If you are looking for a new and exciting foundational theory on which to situate your Web-based educational research, consider cognitive load theory. Having been around for ten years, cognitive load theory is the new kid on the block. Cognitive load theorists have determined that we can experience three distinct types of cognitive load: intrinsic, extraneous, and germane. A cognitive load is “intrinsic” when it is imposed by the number of information elements and their interactivity. If it is imposed by the manner in which the information is presented to learners and by the learning activities required of learners, it is called “extraneous” or “germane.” Whereas, extraneous or ineffective load is imposed by information and activities that do not contribute to the processes of schema construction and automation, germane or effective load is related to information and activities that foster these processes. Intrinsic, extraneous, and germane load are considered additive in that, taken together, the total load cannot exceed the memory resources available if learning is to occur.

Cognitive load theory has many implications for research on Web-based learning. Cognitive load theory is concerned with techniques for managing student’s working memory load to facilitate changes in long term memory associated with schema construction and automation. CLT distinguishes between three types of cognitive load: intrinsic, extraneous and germane.

• Intrinsic cognitive load is the inherent nature of the material. Intrinsic cognitive load is imposed by the number of information elements and their interactivity, the portion of load on our working memory that is imposed by the intrinsic characteristics of the task or subject matter.
• Extraneous cognitive load is the effort required to process poorly-designed instruction. Extraneous cognitive load is considered ineffective load imposed by information or activities that do not contribute to the processes of schema construction and automation.
• Germane cognitive load is the effort that contributes to the construction of schema. Germane cognitive load is considered to be an effective load, and is related to information and activities that foster these processes.

Intrinsic, extraneous, and germane load are considered additive in that, taken together, the total load cannot exceed the memory resources available if learning is to occur (Paas, Tuovinen, Tabbers, & Van Gerven, 2003). A cognitive load that is germane for a novice may be extraneous for an expert. In other words, information that is relevant to the process of schema construction for a beginning learner may hinder this process for a more advanced learner. For this reason, instructional designers should integrate target group analysis with knowledge analysis (hierarchical analysis of the material to be learned) when designing instruction, so that the knowledge can be communicated to the learners at the right grain size (Van Merriënboer, 1997).
Clark’s Delivery Truck Argument

Experimental researchers on Web-based learning should be able to defend their experimental treatments from rival hypotheses, such as Richard Clark’s delivery truck argument. In an article on educational media, Clark claimed in the now famous delivery truck argument:

*Media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition.* (Clark, 1983, p. 445)

Clark has presented evidence in support of the hypothesis that instructional methods had been confounded with media and that it is methods which influence learning. Further, Clark claimed, that any necessary teaching method could be designed into a variety of media presentations. Clark also questioned the unique contributions of media attributes. Gavriel, Salomon and others (Salomon, 1979) had argued that it was not the medium which influenced learning but instead certain attributes of media that can be modeled by learners and can shape the development of unique “cognitive processes.” Examples of media attributes are the capacity of television and movies to “zoom” into detail or to “unwrap” three-dimensional objects into two dimensions. The problem with the media attribute argument is that there is strong evidence that many very different media attributes accomplish the same learning goal (for example, there are a variety of equally effective ways to highlight details other than zooming). In every attempt to replicate the published media attribute studies a number of very different media attributes served the same or similar cognitive functions. This point is critical to my argument. If there is no single media attribute that serves a unique cognitive effect for some learning task, then the attributes must be proxies for some other variables that are instrumental in learning gains.

Richard Clark further advises us not to attempt to conduct research to answer questions such as “Should I compare learning from Medium A (Web) vs. Medium B (lecture)?” Or “Should I compare the Web against a teacher as a medium of learning?” A somewhat more controlled version would is “Should I compare a Web lecture against a teacher’s lecture as a medium of learning?” The majority of readers would say “yes, absolutely.” We need to know and compare a Web lecture against a teacher’s lecture as a medium of learning.

“The Classroom” is Not a Control Group

The classroom lecture is another treatment, not a control group. Rather, classroom work should be integrated into all experiential treatments to avoid bias, namely: the demotivating effect of one group using a computer another using a pencil and paper.
Thesis Research in Web-Based Experiments

Questions for Students:
1. What were the independent variables in Hogg’s study?
2. How did she control for age differences?

Cognitive load theory and HTML. In 2004 Nanette Hogg completed a Ph.D. degree at the University of Nebraska, Lincoln with a thesis on “Designing Instructional Materials for Teaching HTML to Create Web Page Tables: Applying Cognitive Load Theory.” The purpose of her study was to determine the effects of instructional method and prior knowledge level when learning highly interactive material on the variables of test scores, test time, study time, and cognitive load as rated by the participant. The material used in this study was the highly interactive code and attributes to create HTML tables. The subjects were 69 males and 82 females who ranged in age from 19 to 55. They were randomly assigned to one of three instructional methods (Isolation Group, Interaction Group, and Choice Group). Three instruments were used during this experiment: a prior knowledge test, a subjective rating scale to measure cognitive load, and a post-test to measure the learning that took place during the instructional phase. The dependent variables were the subjective cognitive load rating scale scores, the time spent studying, the time spent taking the test, and the test scores. Four two-factor analyses of variances (ANOVA) were used to analyze the data, one ANOVA for each dependent variable. Factor A for each analysis was the level of HTML experience indicated by the subjects, and Factor B was the instructional method to which the subjects were randomly assigned. A computer program was used to present the instructional material, recorded answers to the practice and the test questions, and recorded the time spent in the study section and in the test section. The program also recorded the subjective rating after each instructional section, each practice question, and each test question. Results indicated that prior knowledge had significant effects on cognitive load rating, test scores, and time to complete the test. The groups with no prior knowledge of HTML reported significantly higher cognitive load, took less time to complete the test and had significantly lower test scores. The groups with high prior knowledge of HTML had significantly higher test scores and took significantly longer time to complete the test with significantly lower mental effort.

Question for Students:
1. In Chuo’s study, what was the effect of the Webquest writing instruction on EFL learners’ writing performance, writing apprehension, and perception?

Webquest writing. In 2004, Tun-Whei Isabel Chuo completed Ed.D. at La Sierra University on “The Effect of the WebQuest Writing Instruction on EFL Learners’ Writing Performance, Writing Apprehension, and Perception.” The study investigated the effect
of the WWI on students’ writing performance and writing apprehension. In addition, it
examined students’ perception of Web-resource integrated language learning as expe-
rienced in the WWI and sought to determine the relationship between students’
perception and the change in their writing performance and writing apprehension over
the instruction process. Students in two junior college second-year classes at a college
of foreign languages in southern Taiwan provided the subjects of this study. One class
(N = 52), as the control group, received traditional classroom writing instruction. The
other class (N = 51), the experimental group, received the WWI. Both groups used the
process writing approach. In the control group, teacher-directed oral discussion in the
traditional classroom provided the primary writing input. In the experiment group, the
WebQuest lessons directed students to surf Web resources for writing input. Data
collected included a writing performance test and a writing apprehension test adminis-
tered to both groups and a post-instruction perception questionnaire administered to the
experimental group. The research project was conducted within a 14-week period.
The results indicated that the WWI improved students’ writing performance signifi-
cantly more than the traditional writing instruction. The WWI class also experienced
significant reduction in writing apprehension. However, no significant difference in
reduced apprehension could be found between the WWI class and the control group.
In addition, students had a favorable perception of the WWI, recognizing more advan-
tages than disadvantages of language learning through Web resources. Nonetheless,
no significant correlation could be detected between students’ perception and their
improved writing performance. Neither was there a significant relationship between
students’ perception and their reduced writing apprehension. The findings suggested
that integrating Web resources into EFL writing instruction, using the WebQuest model,
was effective for enhancing students’ writing performance and provided a positive
learning experience. It is thus recommended that EFL teaching practitioners adopt the
WebQuest model in making use of Web resources for their instruction. Since very few
studies of this kind have been conducted, further research is warranted to shed light on
the effectiveness of WebQuest-based pedagogy on EFL learning.

Question for Students:

1. In Carr’s thesis, why did students from disadvantaged backgrounds get special
treatment?

Math and the Web. Benjamin Carr earned a D.Phil. degree in 2003 from the University of
Pretoria in South Africa with the thesis “Information, Knowledge and Learning: Is the
Web Effective as a Medium for Mathematics Teaching?” This document is a report on
an experiment in which mathematical skills were taught to first-year university students
using the Web as a method of instructional delivery. Special attention was paid to the
ability of students from disadvantaged backgrounds to cope with this method of
delivery. Overall, the results obtained by students using this method were slightly better
than that of students on the equivalent paper-based course. However, students from
disadvantaged backgrounds fared marginally worse than those on the paper-based
course. The results of these students allow extrapolation to a broader context where
Web-based teaching of disadvantaged communities may be used. Definitions for
knowledge, information, learning and teaching were developed. These definitions were then used as the foundation for creating the Web pages used in the experiment.

Questions for Students:
1. Describe the treatment conditions in Part One of Tang’s study.
2. What were the independent variables in Tang’s study?
3. Why was “user interaction” important in this research?

Control and interactivity. In 2004, Zhihua Tang completed a Ph.D. degree at Rice University with the thesis “Learner Control in an Interactive Learning Environment.” The research examined learner control in an interactive learning environment from two perspectives. In Part I of the thesis, three experiments were conducted to compare simulation-based interactive learning with expository learning in learning statistics. In Experiment 1, interactive learning was compared to textbook-based expository learning. Interactive learning was structured in two different ways so that learners received either directive or nondirective guidance while interacting with the simulation. Compared to expository learning, learner control resulted in slightly improved but much more consistent performance on a knowledge test as well as more positive affect towards learning. In Experiment 2, learner control was compared to simulation-based expository learning. In each learning condition, half of the participants were further asked to predict simulation outcomes during the learning process. Interactive learning resulted in significantly higher response accuracy on the knowledge test than did expository learning. It also improved learners’ performance on a transfer test for those with medium lower cognitive ability. Making predictions was more beneficial for interactive learning than for expository learning. Experiment 3 examined the effects of interactive learning over time. The expository learning group was yoked with the interactive learning group by passively observing their interaction with the simulation. Participants were tested either immediately after learning or after a one-week delay. Performances of the interactive learning group remained stable over this period of time. However, learner control did not improve learners’ performance compared to expository learning. Reasons for this finding were discussed. In Part II of the thesis, two iterations of user testing were conducted to examine user interaction with the Connexions Web-based learning environment. User interaction was considered an integral part of learner control in such a complex environment. Usability information gathered from user testing was used to aid the software development effort. The current research supported the idea that learner control can lead to better learning than expository learning but emphasized the importance of learning structure and potential aptitude-treatment interaction in simulation-based interactive learning. These findings have implications for larger-scale interactive learning environments such as Web-based learning.

Questions for Students:
1. State the dependent variables in Carter’s thesis research.
2. Describe the characteristics of the treatment and control groups.
Remedial math on the Web. Marthea Bernadette Carter completed an Ed.D. in 2004. Her thesis title was “An Analysis and Comparison of the Effects of Web-Based Computer-Assisted Instruction versus Traditional Lecture Instruction on Student Attitudes and Achievement in a College Remedial Mathematics Course.” Remedial mathematics courses are often taught at post-secondary institutions in response to the substantial number of students entering college who lack the skills and motivation necessary to be successful in college level mathematics courses. Much of the research on remedial mathematics instruction shows that it has been only moderately successful in improving the students’ achievement in mathematics or their attitudes towards mathematics. The purpose of this study was to compare the effectiveness of Web-based computer-assisted instruction (CAI) and traditional lecture-based instruction in a college remedial mathematics course. The remedial mathematics course was taught to two groups of college students, which included a treatment group that received CAI, and a control group that received traditional lecture instruction without the use of computers. The ALEKS (Assessment and Learning in Knowledge Spaces) Web-based software program was used in conjunction with lecture-based instruction for the treatment group. Mathematics achievement and student attitudes towards mathematics were assessed by means of pre- and post-tests administered at the beginning of the semester and again at the end of the semester. Student withdrawal rates and passing rates for the course were also compared for the two groups.

The statistical analysis of the data compiled in this study included the use of paired and independent group t-tests, analysis of covariance, and z-tests. The paired t-test results showed that there were statistically significant achievement gains within the treatment and control groups as a result of the instruction that each group received. However, the independent t-tests and the Analysis of Covariance (ANCOVA) revealed that there was no statistically significant difference in achievement gains between the two groups when the study ended. The paired t-test results on the attitude assessment showed no statistically significant difference within each group after the study was completed. In addition, the independent t-tests and the ANCOVA results showed no significant change in attitudes between the two groups when the experiment had been completed. The z-test analyses also showed no significant difference in the withdrawal or passing rates between the treatment and control groups.

Collaborative vs. cooperative structures in PBL. Mary Rose completed the Ed.D. degree at Indiana University in 2002 with the thesis “Cognitive Dialogue, Interaction Patterns, and Perceptions of Graduate Students in an Online Conferencing Environment Under Collaborative and Cooperative Structures.” This study examined how the dialogue and perceptions of groups of graduate students engaged in problem-based learning (PBL) and interacting in an asynchronous computer conference differed under two group structures. Six heterogenous groups were assigned to one of two group structures, a cooperative structure employing role assignment and frequent monitoring by the instructor, or a collaborative structure that emphasized the use of critical dialogue and employed infrequent instructor monitoring. A mixed methods approached was employed to examine the impact of group structure during the six-week PBL activity. Using Henri and Rigault’s (1996) framework, the content of the online transcript was coded according to function, cognitive skill, and level of processing. An analysis of the interconnectedness of messages was conducted according to the guidelines of Howell-Richardson and
Mellar (1996). Group’s perceptions of interdependence and intersubjectivity were aggregated from the individual results of a self-reported survey developed by the researcher. Advocates of a more structured cooperative learning approach generally assert that assigning roles to group members results in quicker, more consistent levels of interaction, while advocates of the collaborative approach generally contend that less structure stimulates more elaborate, critical dialogue. Evidence from this study supports the first assertion.

Comparisons revealed that the cooperative structure was more potent in generating higher levels of interconnected messages over the entire PBL activity. Weekly comparisons also showed that the cooperative structure promoted higher perceptions of intersubjectivity and higher percentages of deep processing during the initial weeks of the activity; however, these levels equalized across group structures over time. An implication for facilitators and designers of peer-directed learning in ACCs is that assigning roles and providing close monitoring of group interaction creates learning advantages in the short term. However, small groups may approach similar levels of productive interaction in the long term without the added instructional expense. In addition, the patterns and relative presence of dialogue function and cognitive skill use suggest that specific scaffolds or instructional interventions should be employed to encourage learners to deeply and critically engage the learning issues.

Procedures/Student Checklist

Introduction

• I’ve written a research question/problem [idea-based (like an intervention) or data-driven (like causal-comparative)]

Literature Review

• Theoretical framework to support the questions, problem, needs, and a summary

Methodology

• I’ve described the participants [e.g., level, prerequisites, prior knowledge of the dependent variable under consideration, motivation to learn, intrinsic, better job, etc.].
• I’ve described the materials in depth [e.g., online, tools, software utilities, workbooks, writing materials, verbal instructions, etc.].
• I’ve described the research design [e.g., hypotheses, sampling method] variables [e.g., dependent, independent].

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• I’ve described the instrumentation [e.g., written test, time stamping, dribble files, interview questions, written work, method of segmentating protocols, etc.].
• I’ve described the procedure [e.g., “the procedure in this study followed those suggested in previous studies of this kind (reference),” and summary].

Results

• I’ve described the data analysis methods
• I’ve described the pretest results of prior knowledge, predisposition to study style or modality, post-test results of treatment effects, delayed or retention test results, and written a summary

Discussion

• I’ve made a statement linking results with previous research [“the results arising from the analyses of these data augment previous research”], conclusions of the study, contributing factors, implications of the study, limitations of the study, recommendations, and a summary
• My references are APA
• I’ve added the tests in the appendices
• I wrote my abstract last

References


Mayer, R. E. (2002). Cognitive theory and the design of multimedia instruction: An example of the two-way street between cognition and instruction. *New Directions For Teaching And Learning, 89*.


