THE EFFECTS OF CBI LESSON SEQUENCE TYPE AND FIELD DEPENDENCE ON LEARNING FROM COMPUTER-BASED COOPERATIVE INSTRUCTION IN WEB

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ABSTRACT
The purpose of this study was to investigate the effects of CBI lesson sequence type and cognitive style of field dependence on learning from Computer-Based Cooperative Instruction (CBCI) in WEB on the dependent measures, achievement, reading comprehension and reading rate. Eighty-seven college undergraduate students were randomly assigned to lesson sequence type levels, after assigning into three cognitive style group: field dependent (FD), field neutral (FN) and field independent (FI), based on the Group Embedded Figure Test (GEFT) scores. Instruction was delivered by means of two types of sequence of lessons for CBCI in WEB, linear lesson (LL) and branching lesson (BL). A two-way analysis of covariance was used to investigate whether there are main effects and interactions between cognitive style of field dependence and lesson sequence types. In order to control statistical power and to equate the treatment groups, Nelson-Denny Reading Comprehension Test scores were used as a covariate. The analysis of regression coefficients between lesson sequence type and dependent variables and between field dependence and dependent variables was shown in tables. Although the findings show non-significance in formal tests of hypotheses, the interaction effects between field dependence and lesson sequence types on dependent measures were clarified. Four research questions converted to statistical hypotheses were tested according to the factorial design model. Specifically, the tests of hypotheses generated discussion and conclusions were given at the end of the study.
Keywords: CBI Lesson sequence type, Field dependence, Computer based cooperative instruction, Web based learning

INTRODUCTION

In the past thirty-five years, computer-based instruction (CBI) has been in improving both learner performance and achievement with different instructional and learning environments (Alessi & Trollip, 1991, 2001; C. Kulik & Kulik, 1986; Ipek, 2001; J. Kulik & Kulik, 1987, 1991; J. A. Kulik, Kulik & Cohen, 1980; J. A. Kulik, Bangert & Williams, 1983). Instructional setting environments are defined such as cooperative, competitive, and individual setting (Johnson and Johnson, 1985; Malheiro, Morgado & Mendes, 2008; Slavin, 1980a, 1980b). In cooperative learning, students work together, the actions of each student affect the others in the group. Each student takes a mutual goal. Students in cooperative learning situations celebrate each other's successes, encourage each other to complete the assigned work, help each other, learn to work together regardless of individual differences.

Recently, CBI process requires new instructional design links to learning for providing new ways in the development of instructional software or instructional courseware. The ways are delivering information, providing performance computation and including multimedia in the course (Schitai, 1998). As a new application or a part of multimedia, adaptive hypermedia (AH) has been used for web-based teaching and learning from its origins until nowadays. Aplications of AH for education will be described as individual guidance, adaptation in colloborative applications, adaptive asessment, vizualization, mobile learning and evaluation (Carro, 2008). The student characteristcs are important for adaptations in instruction and learning design process. One of the user characteristics can be defined in the cognitive style as field dependent, field neutral and field independent. Individual learning based on cognitive style can be prety effective, but it is well know that the involvement of students in cooperative activities contributes to knowledge acquisition which is related to learning skills and computer supported collaborative learning (Bravo, 2008; Carr, Lally, De Laat & Cox, 2006; Carro, 2008).

Cooperative learning in CBI and Web-based instruction (WBI) provide some benefits for the students and schools. For example, new technologies, high equipment and material costs, limited access to computers for instruction in many schools, and the success of cooperative learning strategies in traditional classroom instruction have motivated researchers to examine the potential of cooperative computer-based instruction (CBI) (Rysavy & Sales, 1991). Learner-centered Web instruction can be used effectively for a teamwork in cooperative learning (Bonk & Reynolds, 1997; Grabe & Grabe, 2007; Morgado, Pereira & Mendes, 2008). In addition, a number of cooperative learning methods are available for Web. They are group investigation, project-based

learning, problem-based learning, learning by design, partner activities, round tables and electronic conferences techniques (Bravo, 2008; Grabe & Grabe, 2007). All these cooperative learning techniques are available for the Web.

Learning setting environments are dealing with learner's characteristics. For this reason, cooperative learning activities in CBI and Web based instruction have focused on achievement, ability, social interchange, motivation, attitudes and gender comparisons. The learning situation is based on cognitive styles and learning styles. The learner's cognitive style of field dependence indicates how, when, and what learners intent to learn.. The interaction between the levels of field dependence and sequencing strategies such as linear and branching lessons provide important cues to develop an effective CBI program, tasks, adaptation rules, adaptation capabilities of courses, learning strategies (Carro, 2008) and a lesson in WEB-Based Instruction (WBI) and multimedia and hypermedia in the delivery of CBI (Grabe & Grabe, 2007; Ipek, 2001).

These limitations suggested that research was needed to investigate how learners in different cognitive style were affected from different CBI lesson sequences in a WEB site according to their reading, comprehension, and perception skills. To develop effective CBI lessons, we need to recognize basic factors and new links for WBI, and a lesson designer should be aware of evaluating instructional programs offered by WEB sites, and multimedia systems for the future software and instructional designers. This study may bring an acceptable contribution of lesson sequence segments and computer-supported cooperative learning for the future research, instructional and technological environments with new technologies.

Types of Lesson Sequences in CBI

The simplest type of lesson sequence in CBI programs is the linear sequence. This type of lesson sequence has one topic or concept for presenting information and then asking questions. All students go through the presentation and questions in this order (Alessi & Trollip, 1991; Grabe & Grabe, 2007; Ipek, 2001). In addition, hierarchical sequence, familiarity and difficulty sequence in a linear lesson design are determined by the author. In the linear form of instruction the learner is presented with instructional sequences consisting of text presentations, which are combined with different visuals, questions and feedback. Although there are several instructional structures and sequences, all learners follow same path and format (Grabe & Grabe, 2007; Ipek, 2001; Price, 1991). Linear lesson is a single sequence of instruction that is presented to all learners (Jonassen, 1988). Linear approach permits no choices and no remediation based on learning assessment (Price, 1991).

Another type of sequence in CBI programs is the branching sequence. Branching is the technique for using different ways to learn any content in the program. There are different types of branching, such as forward branch, backward branch, and sideways branchs. In addition, learner-directed branching, review branching, single and multiple remediation branching may be used in CBI. The amount of branching in a CBI program is a continuous variable, ranging from occasional branch points to branching after every student response. Branching does not occur after every question, but it does occur frequently (Alessi & Trollip, 1991, 2001; Ipek, 2001). It also pretest the learner to see how much of the information to be presented in a given sequence is already known (Grabe & Grabe, 2007; Price, 1991). When we talk about branching lessons, amount of branching, criteria for branching and direction of branching should be mentioned. These functions occur based on individual performances, cumulative performance, or student choice. When we apply the rules for a WBI, it is necessary to make a decision about learner's performances and their cognitive style of fielddependence. Branching programs are more complex than linear programs but allow for greater individualization of instruction (Grabe & Grabe, 2007; Ipek, 2001).

Cooperative Learning and Achievement

In cooperative learning groups, group ability composition on achievement has been discussed to show advantages of cooperative settings over competitive or individual setting (Slavin, 1980a, 1980b, 1991, 1995, 1996; Webb, 1980a, 1980b; Sharon, 1980). The effectiveness of cooperative CBI has focused on achievement of students working cooperatively with different lesson sequence groups. Cooperative learning, as an instructional methodology, affects students' needs and their achievements in heterogeneous groups. Because cooperative learning, as mentioned above, was constructed in order to develop learner performance between or within learning groups. Typically, cooperative learning groups consist of two to five students. They are mixed with respect to ability, cognitive style, learner style gender, and ethnic groups. Cooperative learning techniques are hardly new. Cooperative groups provide a way to include students with special needs and cooperation in CBI (Grabe & Grabe, 2007).

Knowing the effects of CBI on student achievement provides benefits for adapting of instruction in different lesson type groups. The process provides us to develop effective instructional strategies for WBI or CBI program (Carro, 2008; Grabe & Grabe, 2007). In addition, effectiveness of CBCI deals with applying instructional methods, creating effective conditions, and considering the type of learning outcomes. These procedures are based on instructional design theories in order to conduct unique instructional strategies for CBI and WBI.(Grabe & Grabe, 2007). The WBI can be designed to ignore or develop cooperative learning. During this time, given an appropriate instructional design, learners in a small group working together to gain shared goals (Reeves & Reeves, 1997). Cooperative learning in colloborative systems can be worked as instructional method in the process and WBI process provides structures and interactions between learners and computer (Bravo, 2008; Carr et al.. 2006; Carro, 2008). The process gives learners instructional and social benefits for collaborative learning. Here, the WBI components and procedures were indicated and discussed effectively. The procedures on Web learning are also well discussed to create effective instructional Web sites and cooperative learning (Khan, 1997). In the last decade, the web instruction was released to use in our classroom as an instructional technology tool (Grabe & Grabe, 2007; Crossman, 1997). Today, the web has unique potential to create more creative learning environments for students and schools.

Human Information Processing and Cognitive Styles

One of the most important aspects of visual communication is perception. Perception deals with awareness of objects in learning environment. The human information processing in psychology provides a foundation for interface design. The human-computer interface is a communications channel between the user and the computer. The interface includes both physical and conceptual components. Physical components include input devices such as mice and touch panels; and output devices such as visual displays and sound. Conceptual components include selection methods such as menus or direct manipulation; and representation schemes such as screen layout and graphics/text mixed (Marchionini, 1991). For the information processing, (1) learners have a working memory limited to information, (2) learners must have their attention refreshed frequently, and (3) recalling information requires more cognitive effort than recognizing information. While working on the Web, the information processing procedures affect human performance for meaningful learning on the WEB. As a learner-centered web instruction, there are alternative strategies such as critical, creative and cooperative learning on the web (Clark & Mayer, 2003; Grabe & Grabe, 2007) In addition, there are several techniques for learning on the web. For example, creative thinking techniques indicate students' willingness to take risks, broad interests, originality, artistic ability, problem finding, commitment to task, elaboration of ideas, and other group performances for creative people. Critical learning techniques provide students with selecting effective methods and ideas. Cooperative learning on the web provide students' teamwork skills to develop ideal strategies for projects. As a result, with WBI processing, students have new learning partners and materials for discovering, producing, and synthesizing knowledge (Bonk & Reynolds, 1997; Mendes, Pereira, & Costa, 2008).

Atkinson & Shiffrin (1968) developed a model for memory involving sensory store, short term memory (STM) and long term memory (LTM) which may be utilized to describe information processing in human-computer interaction. Visual sensory (perception), as a part of sensory store, in information processing provides structures and processes that support learning.

When learners witness an event, it is likely that each learner will describe a somewhat different experience. Their responses are a result of their individual perceptions which are influenced by differences in gender, cognitive styles, social interactions, interests, achievements, learning styles, and abilities (Witkin, 1976). The individual differences in the ways in which information is organized and processed are known as cognitive styles.

Messick (1976) identified more than 20 cognitive styles. This study will deal with only one style, field dependence. According to Messick (1976), the field independent person tends to articulate figures as discrete from their backgrounds and can more easily differentiate objects from the embedding context, whereas the field dependent person tends to experience events globally. Similarly, Jonassen (1989) indicated that the field dependent learner views information on the computer screen globally.

Definitions of terms

Cognitive Styles: Messick (1976) described cognitive styles as "information processing habits representing the learner's typical mode of perceiving, thinking, problem solving, and remembering" (p. 14). Moreover, "they are conceptualized as stable attitudes, preferences, or habitual strategies determining a person's typical modes of perceiving, remembering, thinking and problem solving" (Messick, 1976, P. 5). This study is concerned with the cognitive style of field dependence.

Field Dependence (FD): According to Goodenough & Witkin (1977), field dependence is "the tendency to rely on external referents", whereas field-independence is "the tendency to rely upon internal referents" (p. 189). Field dependence is marked by a propensity for making intuitive responses that are affected by contextual factors, without determining the relevance of these factors. For this study, field dependence levels were determined as field dependent (FD), field neutral (FN), and field independence (FI), based on GEFT scores. Students who achieved one-half standard deviation below the mean were classified as field dependent, and those in the middle were classified as field neutral (FN) (Dwyer & Moore, 1991, 1992, 1994; Ipek, 1995; Lee, 1994; Moore & Dwyer, 1991).

Field Independence (FI) is marked by a propensity for distinguishing and coordinating items extracted from complex backgrounds that may be confusing to others. For this study, students who achieved one half standard deviation above the mean were considered to be field independent (FI).

Linear Lesson (LL) is a single sequence of instruction that is presented to all learners (Jonassen, 1988). They follow same path in the instruction.

Branching Lesson (BL) is the technique for moving from one place to another in the program or software applications (structure).

Achievement: level of knowledge or skill assessed by individual pretest and posttest scores on a WBI lesson, reading comprehension and rate.

Web-Based Instruction (WBI) is can be viewed as an innovative approach for delivering instruction to a remote audience, using the Web as the medium (Khan, 1997).

RESEARCH METHODOLOGY

Purpose: The purposes of this study are to determine if a main effect exists between variations in lesson sequence types on achievement in a WBI lesson, and on reading comprehension and reading rate scores. And if an interaction exists between lesson sequence types and cognitive style of field dependence (1) on achievement levels in a WBI lesson, (2) on reading comprehension and reading rate.

Research Questions

This study focuses on how to design a lesson sequence on the computer and WEB screen for providing contributions into the lesson sequence display in terms of learner characteristics and perception, and human computer interaction (HCI). The study determined the effects of lesson sequence approaches in CBI and cognitive style of field dependence on the dependent variables, the achievement on learning from a Computer-Based Cooperative Instruction (CBCI) in WEB, and reading abilities such as reading comprehension, reading rate. The research questions are:

1. Is there a significant main effect between lesson sequence type (linear lessons versus branching lessons) on achievement in a WEB-Based Instruction?
2. Is there a significant main effect between lesson sequence type (linear lessons versus branching lessons) on the reading comprehension scores?
3. Is there a significant interaction between lesson sequence type (linear lessons versus branching lessons) and the cognitive style of field dependence (FD) measured by achievement in a WEB-Based Instruction ?
4. Is there a significant interaction between lesson sequence type (linear lessons versus branching lessons) and the cognitive style of field dependence (FD) in terms of reading comprehension scores?

Research Design

Procedures: This study utilizes a (2X3) ANCOVA factorial design. Each research question was analyzed by factorial experiments and correlations. To accomplish this, a design model was used to test hypotheses, without which the analysis may not be controlled between parameters.

A two factor experimental research design was employed (Freed, Ryan & Hess, 1991). In this case, one factor is the treatment variable of lesson sequence types, which includes linear lesson (LL) and branching lesson (BL). The second factor is the level of cognitive style. The cognitive style levels were identified as field independent (high), field neutral-FN, and field dependent (low). Field dependence (low) is demonstrated by achieving scores (low scores $(scores < 7\ (\overline{X} - 0.5\sigma)$) on the group embedded figure test, and field independence (high) is

demonstrated by achieving scores (scores $\geq 12\ (\overline{X} + 0.5\sigma)$). Students achieving scores $(7 \leq scores < 12\ (\overline{X} + 0.5\sigma)$ were considered to be field-neutral in the study. The test takes approximately 20 minutes for a subject to complete. Materials created by researcher were used to facilitate and examine the performance of students. The GEFT results are summarized in Table 1 and Figure 1. The study employs a randomized blocks design by assuming three cognitive style blocks of subjects in the experiment as a fixed effect model. Stratified randomization was used to assign subjects to treatment groups.

A series of two-way analysis of covariance was used to analyze the data. In order to control statistical power and to equate the treatment groups (LL/BL), Nelson-Denny Reading Comprehension Test (N-DRCT) scores were used as a covariate. In addition, SPSS® for Unix (version 6.1), a statistical software package was used. To check the validity and the power of prediction, simple regression and Pearson-product-moment correlation coefficients were calculated for the measured two variables using StatView 512+™. In addition, reliability and validity were reviewed for the instructional materials using a covariate measure and judge validity, respectively. The WBI lesson was reviewed by twenty undergraduate students who were taking a computer literacy course at the Faculty of Humanities and Letters, and Faculty of Business Administration at Bilkent University in Turkey. In addition, pretest and posttest instructional materials were pilot tested using a group of five graduate students, and used for the previous studies (Ipek, 1995, 1997, 1998). The process was conducted based on formative evaluation.

The mean differences of dependent measures were analyzed to clarify the main effects by using regression analysis, ANCOVA and ANOVA. And then the interaction effects between field dependence and lesson sequence type on dependent measures were clarified.

	Treatment Variables	
	Linear Lesson (LL)	Branch Lesson (LL)
Group Levels (FD) Field Dependent	N = 16	N = 17
(FN) Field Neutral	N = 14	N = 13
(FI) Field Independent	N = 14	N = 13
Total	N = 44	N = 43

Figure 1 Numbers of Subjects with Design of the Study

The research design model will be formulated as follows.

R G1 O1 X O2
R G2 O3 X O4

Participants: Eighty-seven college freshman students at Bilkent University in Ankara, Turkey, were randomly assigned to lesson sequence types, after assigning into three cognitive style groups (FD, FN, and FI). The Group Embedded Figure Test (GEFT) was used to determine their cognitive style levels as FD, FN, and FI. All subjects were volunteers. They have worked based on cooperative learning rules. They were in different programs not in a geology program and their language (Turkish) was native for them and English is a second language. Instruction at the university is in English.

Research Variables: Independent variables of the study were the levels of field dependence and lesson sequence types. Dependent variables were achievement in geology and reading comprehension.

Research Materials (Instruments)

Group Embedded Figure Test (GEFT): This is a version of the Embedded Figures Test (EFT). It can be used for group administration to measure of FD students (Witkin, Oltman, Raskin, & Karp, 1971; Goldstein & Blackman, 1978). For this study, GEFT will be administered in a 20-minute testing session. The test contains three sections: the first section, which contains 7 simple items, and second and third sections, each of which contains 9 more difficult items. The reliability is r= .82. The validity with criterion variable has been found the range of .63 to .82.

WBI Versions of Lessons: WBI versions of the linear (LL) and branching lessons (BL) were selected directly from the WEB site which are used to teaching fundamentals of geology course for students on the Internet. For this research, the unit in geology WEB includes three lessons covering the volcano, types of volcanoes, and volcanic eruptions. The WBI lesson which is named volcanoes at http: //volcano.und.nodak.edu/vw.html was used to teach volcanoes in the Internet. Based on this WEB site, directions for linear and branching lesson groups were given. To use the WEB site, the characteristics of linear and branching lessons were defined and distributed as a manual to learners and users to follow them during the WBI. Each lesson has subcategories to elaborate instruction menu. The WBI lessons were used to measure dependent variables and their effects for this study.

Pretest: A pretest was given to determine the learner's experience in the fundamentals of geology. To provide additional support for this, learners' backgrounds and experiences with related courses were used to ascertain their knowledge about the subject. The pretest and other criteria were used to control and eliminate these negative effects between treatment groups. The test consisted of ten items. These items are considered to test prior knowledge and incoming information about a text. As a result, the internal consistency reliability of the test was calculated by the KR-20 formula and reached this result: (r_{xy}=.52).

Reading Test: The Nelson-Denny Reading test (form E or F) (Brown, 1981) was administered to assess student reading comprehension and reading rate.

Posttest*:* A posttest was used to define improvements and achievement levels in geology for text density in the CBI tutorial. Field dependent learners have different achievement scores in class, according to the literature. There is a factor that is defined such as text density levels. The posttest results were evaluated to define the effects of lesson sequence types in learning for field dependent learners. There were a number of indications for the content, text style, objectives, and cognitive effects in the instructional process. Additionally, the posttest questions were written and adapted from the test banks of fundamental geology textbooks for the general studies program. For this reason, test items for this study had high reliability and validity. KR-20 Internal consistency reliabilities of the total test were calculated. The reliability of the posttest was found to be r_{xy}=.65. The total test consisted of 15 items. To prepare the posttest, the crosstabulation table was conducted in two dimensions for objectives and content. After writing objectives, the researcher decided how many test items were necessary to control for objectives reached for a text in Web. In accordance with the testing literature, each objective was examined by at least one or more test items to support lesson sequence types approach.

Table 1 □ Means and standard deviations on GEFT scores (n = 87)

	n	Mean	Std. Dev.	Std. Error	Min.	Max.
Sex						
male	30	11.4	5.4	.993	1	18
female	57	7.9	4.0	.535	3	18
LT						
LL	44	9.2	5.0	.747	1	18
BL	43	9.1	4.8	.724	1	18
FDI						
FD	33	4.3	1.7	.287	1	6
FN	27	8.9	1.5	.287	7	11
FI	27	15.3	1.7	.327	12	18

Data Gathering Procedures

Learners were provided with either a linear lesson (LL) type or a branching lesson (HD) type presentation. A computer lab at Bilkent University was used to complete the study and gather information. Before beginning the lessons, participants were given the GEFT to define their cognitive styles. This test has a firm research base, is inexpensive, and is usable for group administration. Researchers have found high validity and reliability scores on the GEFT (Witkin et al., 1971). Participants were then randomly assigned to treatment groups, as seen in

Figure 1. The pretest was administrated before presenting the Web lessons. The Web lessons were then presented and taught for an hour in a week at the computer lab using computers. The lesson time varied across participants. No time limitation was imposed for studying with either Web version. The reading comprehension tests were given to determine student reading comprehension and reading rates. Upon completion of the Web lessons, participants took an achievement test in the CBI tutorial. The computer program automatically recorded the scores of the posttest achievement on each multiple-choice item.

Data Analysis

The first step in analyzing the results of a factorial experiment is usually to gather complete descriptive statistics for a group representing each combination of factors. The mean score of the students on problems representing each of the four combinations (cells) of factors are shown. In addition, correlations between variables and treatment groups were calculated by the Pearson-product-moment correlation matrix.

The next step in analyzing the results of this experiment was to perform an analysis of covariance (ANCOVA) and-using the Nelson-Denny Reading Comprehension Test (N-DRCT) score as a covariate-regression analysis to determine whether the differences between mean scores were statistically significant. If there were differences between at least two groups, according to F ratios, the t test was used to compare treatment groups. As a result, all null hypotheses were tested by F tests to consider the effectiveness or effects of independent variables on dependent variables in the study.

Based on these considerations, a series of two-way analysis of covariance (ANCOVA) was used to test the mean differences of achievement, reading comprehension, reading rate, and lesson completion time for the cognitive style of field dependence (FD/FN/FI) and the lesson sequence types (LL/BL) as two independent factors. In order to control statistical power and to equate the treatment groups (LL/BL), the Nelson-Denny Reading Comprehension Test (N-DRCT) scores were used as a covariate. The correlation between the N-DRCT and achievement scores and the GEFT scores were used to interpret reading comprehension scores for predicting the scores of dependent variables and the effectiveness of independent variables on dependent variables.

For the present study, all statistical analyses were done using a statistical package for Social Sciences (SPSS for Unix version 6.1) on the mainframe, at the Bilkent University Computer Center. To check the validity and the power of prediction, simple regression and Pearson-product-moment correlation coefficients were calculated for the two measured variables using StatView 512+™. In addition, reliability and validity were reviewed for the instructional materials using a covariate measure and judge validity, respectively. The mean differences of dependent measures were analyzed to clarify the main effects by using regression analysis, ANCOVA, and ANOVA. Next, the interaction effects between field dependence and lesson sequence types on dependent measures were clarified. The four research questions converted to statistical hypotheses were tested according to the factorial design model.

Results and Findings

The purpose of the study was to investigate the effects of lesson sequence type and the cognitive style of field dependence on learning from a Web site, based on the dependent measures of achievement, reading comprehension and reading rate. Materials created by the researcher were used to facilitate and examine the performance of students. The independent variables were the levels of cognitive styles (FD/FN/FI) and lesson sequence type (LL/BL). Table 2 presents the means and standard deviations achieved by students in the different treatment categories on the criterion measures such as pretest-posttest (gain) and reading comprehension.

According to the results of the analysis, a Pearson correlation coefficient of .05 between N-DRCT and achievement test scores was obtained. The regression equation for relating the dependent variable is indicating a very low positive relationship between N-DRCT and achievement scores (r_X = .17). The regression equation for relating pre-posttest difference (gaining) scores to the N-DRCT score is indicating a negative relationship between the gaining score and N-DRCT score (r_X = -.05). The correlation is not meaningful enough to explain information for N-DRCT scores and GEFT scores.

Because no interaction was found between factors, I preferred to compare relationships among variables using the posttest achievements of the Web geology site. The main effects can be interpreted directly. The regression equation for relating the N-DRCT and GEFT scores is indicating a positive relationship between N-DRCT and GEFT scores (r_X = .29).

Table 2 Means and Standard Deviations on Criterion Measures For Subjects in Treatments

Field Dependence			Achievement Scores	N-DRCT Scores	R. Rate
LL					
FD	N=16	M	6.5	25.6	163.6
		SD	2.1	8.9	65.8
FN	N=14	M	4.6	28.0	176.86
		SD	1.3	7.5	58.
FI	N=14	M	5.7	29.7	212.86
		SD	1.7	9.6	117.27
Total	N=44	M	5.6	27.7	183.50
		SD	1.9	8.7	84.53
BL					
FD	N=17	M	5.4	22.9	160.35
		SD	2.9	6.5	64.88
FN	N=13	M	5.2	26.2	172.84
		SD	1.5	8.6	67.43
FI	N=13	M	5.3	31.5	207.07
		SD	1.6	8.5	51.1
Total	N=43	M	5.3	26.5	178.25
		SD	1.8	8.4	63.62
	N=87	M	5.5	27.1	180.91
		SD	1.8	8.5	74.54

The positive relationship between N-DRCT and post test (rx=.17) is indicated with the equation. It is important to note that reading comprehension and reading rate are closely related to how learners read a text from a computer screen. Both the reading and the reading rate test indicate very low positive relationships among GEFT scores and FDI levels (r_X = .29 r_X = .31, respectively) (see Table 3). Table 3 indicates the correlation matrix for all measures. The table is important to carry information for future research and to indicate positive and negative relationships in order to clarify how much variables can be changed within and between the groups. These scores can be used for predicting the other criterion variable, when needed. For example, the correlation coefficient between two measures would be used to predict another test performance. The regression coefficient equals the covariance between dependent and independent variables divided by the variance of the independent variable. The absolute value of the regression coefficient will always be larger than the absolute value of the correlation coefficient, when there is more variability of scores on the criterion variable than on the predictor variable. Table 4 indicates means and standard deviations of variables to illustrate their variances in the population.

Table 3 Correlation Coefficients Matrix for All Variables (measures)

	LT	FDI	GEFT	Pre	Post	R.C	R.R.	Gain
LT	1.00							
FDI	-.029	1.00						
GEFT	-.019	.94	1.00					
Pre	.13	.13	.11	1.00				
Post	-.08	-.10	-.05	.15	1.00			
R.Com	-.07	.31	.29	.06	.17	1.00		
R.R	-.04	.27	.26	-.04	-.04	.37	1.00	
Gain	-.16	-.18	-.12	-.52	.75	.12	.05	1.00

Table 4 Means, Median and Standard Deviations on all Measures Scores (N= 87)

	Mean	Std. Dev.	Min.	Max.
LT	1.49	.05	1	2
FDI	1.93	.83	1	3
GEFT	9.14	4.82	1	18
Pretest	2.9	1.35	0	7
Posttest	5.49	1.83	2	9
R. Rate	180.8	74.42	60	529
Reading Comp.	27.13	8.52	10	48
Pre-post diff.	2.6	2.1	-2	8

The study shows the analysis of regression coefficients between lesson sequence type and dependent variables ($F_{3,86}$ = 0.26, p>.05). When the standard deviations are equal, the regression and correlation coefficients are equal. These groups have different standard deviations (see Table 4); therefore, the regression and correlation coefficients are not equal. The result indicates a variance of the groups. The magnitude of the regression coefficient is directly proportional to the correlation coefficient. The study shows regression coefficients between field dependence and dependent variables ($F_{4,86}$= 4.162, p > .05).

R-Squared (R^2) provides an index of how well the independent variables predict the dependent measure. R^2 is the proportion of the variation in the dependent measure that is accounted for by the prediction made from the independent variables. As shown in study, approximately 10% variance may be explained from the field dependence groups. This means that 10% prediction would be possible for a factor. In other words, the standard error of estimate would be the same between observed and predicted values of the dependent measures. These results indicate that N-DRCT, as a covariate, may not indicate enough power to explain its purpose with dependent variables, because the relationship is not strong enough, and the covariate is used to reduce the estimate of random or error variance in the dependent measure. ANCOVA assumes that the relationships between the covariate and the dependent measure are statistically equivalent within all groups or cells in the design. In brief, research results are given to clarify findings as follows.

1. Is there a significant main effect between lesson sequence type (linear lessons versus branching lessons) on achievement in a WEB-Based Instruction?
A two-way analysis of covariance was used with achievement tests (pretest and posttest) on the CBI geology tutorial lesson sequence types, with N-DRCT scores as a covariate. Achievement test results indicated no significant differences between treatment levels using LL and BL types ($F_{3, 86}$ = 0.26 p > .05).

2. Is there a significant main effect between lesson sequence type (linear lessons versus branching lessons) on the reading comprehension scores?
A two-way analysis of covariance was used with N-DRCT scores as a covariate. According to the analysis, there is no main effect on the reading scores. However, a two-way analysis of variance was used to analyze the effects of treatment groups on reading scores. Reading comprehension scores indicated no significant differences for using the LL and BL sequence type group (LL/BD) ($F_{1,81}$) = 0.234, p > .05). Also no interaction was noted between the two factors.

3. Is there a significant interaction between lesson sequence type (linear lessons versus branching lessons) and the cognitive style of field dependence (FD) as measured by achievement in a WEB-Based Instruction ?
A non-significant interaction was noted between lesson sequence type (LL and BL) and the cognitive style of field dependence (FD/FN/FI) ($F_{2,80}$) = 1.773, p > .05). The study shows the summary of the analysis for the gain score between the pretest and posttest difference. In addition, the study shows comparison among FDI levels and lesson sequence type on achievement (posttest) in the WBI (see table 5).

4. Is there a significant interaction between lesson sequence type (linear lessons versus branching lessons) and the cognitive style of field dependence (FD) in terms of reading comprehension scores?
A two-way analysis of variance was used with reading comprehension and reading rate scores. A non-significant interaction was noted between treatment groups (LL/BL) and field dependence (FD/FN/FI) levels using N-DRCT scores ($F_{2,81}$ = 0.574 p > .05).

Table 5 Summary of ANCOVA for Achievement Scores on WBI

	DF:	S S:	M S:	F-Value	p-value
LT	1	0.208	0.208	0.066	0.798
FDI	2	21.181	10.591	3.348	0.040
LT*FDI	2	11.023	5.512	1.773	0.176
Covar.(N-DRCT)	1	12.187	12.187	3.852	0.053
Total	86	289.747	3.369		

DISCUSSION AND CONCLUSIONS
Although the findings show non-significance in formal tests of hypotheses, a preference for branching lesson sequence was found. Specifically, the tests of hypotheses generated the following discussion and conclusions:

1. No significant differences occurred between students receiving the different lesson sequence type (LL and BL) on the achievement and learning scores from the WBI. The values for LL students ($\overline{X}$ = 5.64 Std Dev. = 1.90 and BL students ($\overline{X}$ = 5.34 Std. Dev. = 1.77) are without significance. Participants displayed preferences while working. Movement within the WBI screens is different and is based on learners' experiences in using computer and technology. Branching lesson type (BL) takes more time and effort than linear lesson type (LL) in WBI. The finding indicates that we needed research to indicate preferences for the variations of lesson sequence levels in the CBI tutorial and CBI lessons on the Web system. It is important to note that subjects' learning achievement, defined as a pretest and posttest difference score, shows some learning from the Web geology instruction although no significant main effect is indicated statistically. Results, according to descriptive statistics, indicate meaningful relationships in perceptual processes for the learners (see for the correlation matrix). For instance, human factors such as simplicity, student-computer dialogue, social amenities, spaciousness and relevance (Rambally & Rambally, 1987), and experience using computers seem to be important factors for recognizing students' learning in CBCI and WBI lessons (Bang & Dalsgard, 2006; Grabe & Grabe, 2007, Sorensen & Ó Murchú, 2006).

On the achievement test, students using LL sequence type ($\overline{X}$ = 5.64) achieved scores close to those of students using BL text type ($\overline{X}$ = 5.34). These results indicate that there are no significant differences between two lesson sequence types. This present study is consistent with the previous reviews of the literature. In other situations, because of a lack of main effects and interaction, the achievement score (posttest) in the WBI was taken as a criterion measure to compare the effectiveness of the mean values of dependent measures.

Gain score, learning from CBCI in WEB, indicates same result as well as achievement (post) score. It would be possible that the majority of students prefers to work with branching sequence lessons based on a lack of their computer experience and reading globally. A lack of computer experience may cause loss of attention and recognition for the lesson when subjects use WBI and technology. Visual movement for variations of text density levels would be complex in human information processing as a perception and human memory system. The situation in this study considers experience in computer use, in that all classes of subjects were taking their first technology and computer applications course at the university at the same time. That reason suggests a problem from one perspective in that receiving BL students focused on the WBI lessons for learning better than receiving LL students.

2. Reading comprehension from the computer screen was expected to be theoretically different for the cognitive styles and lesson sequence types. As indicated by Baker & Anderson (1982) and Garner & Reis (1981) comprehension may be related to cognitive style. Cognitive styles have predictive power to delineate comprehension abilities (Pitts & Thompson, 1984). For example, monitoring abilities such as schema-familiar and schema-unfamiliar text may have important implications for instruction and for the development of WBI computer screen (Pitts & Thompson, 1984). Moreover, as indicated by Spiro & Tirre (1980), field dependent students do not use prior knowledge as efficiently as do field independent students.

There was no significant main effect between lesson sequence types on reading comprehension scores, monitoring and operating abilities for successful reading from the computer screen in WBI. If students have difficulties with application of general rules for screen interface, they may not display high scores in their WBI lessons. From the correlation matrix, the negative relationship between lesson sequence types and reading comprehension scores was shown (r = -.07).

As shown in the findings, however, both LL and BL lesson sequence types, relative to reading scores, were not found to be significantly different in reading comprehension ($F_{1,86}$= 0.375, p> .05). However, a correlation between GEFT and reading comprehension was indicated (r = .29). The low correlation would be based on a lack of reading comprehension because of students' second language. For this reason, the situation does not indicate expected findings. It was assumed that FI learning style is better than others at the college education. As noted previously from the literature FI students gained higher scores than FD and FN students (Dwyer & Moore, 1991, 1992, 1994; Ipek, 1995, Ipek, 1997, 1998; Ipek & Bayram, 1996; Lee, 1994; Moore & Bedient, 1986; Moore & Dwyer, 1991).

A non-significant interaction was noted between lesson sequence types and field dependence on achievement in a WBI geology lesson. It would be possible to see an interaction between two factors working with a large sample and a different content area, grade, and providing visual attention for the students (Grabe & Grabe, 2007; Henderson, 1992; Kintsch, 1980).

Further investigation of the various lesson sequence levels in WBI development and applications should be performed to review mean differences and their distributions for the effective screen design and cooperative learning strategies. The study was limited to investigating only two types of lesson sequence and levels. We need a clear definition of the lesson sequence strategies and their preferred styles for using WBI and Web design. The performance provides strategies for how perceptual behaviors, cognitive, and technological factors effectively support to create an instructionally effective WBI screen design with various lesson sequences. There was still lack of experimental information to support and clarify the effects of cognitive styles by means of perception, cognition and learners characteristics. We need to know how lesson sequence types may be able to effect teaching and learning processes for the different grades, levels, and disability learners according to their cognitive style of field dependence. Second, human characteristics such as intelligence, cognitive styles and interests, interface design, and a combination of the effects of designer, user, and system should be checked to develop effective instructional strategies in CBCI in Web (Carr et al., 2006; Carro, 2008; Eysenck, 1993; Grabe & Grabe, 2007; Kintsch, 1980; Rayner, 1992; Reinking, 1988). Further research should focus on variations of lesson sequence strategies and cognitive styles in psychological foundations that combine the effects of learners characteristics, technological factors and instructional design systems to achieve high scores with success in our classrooms via WBI.

3. In the present study, no significant interaction was observed between cognitive style of field dependence and lesson sequence types on the reading comprehension scores. However, it was expected that instructional conditions with visual effects would have been affected by level of study, reading speed, reading comprehension and students' performance. There are significant differences in treatment of both LL and BL. There is no significance on the reading test separately.

Notably, there is no interaction between the two main factors. However, reading comprehension scores for both lesson sequence type (LL/BL) were found to be no significant. Both reading comprehension abilities and perceptions to find a hidden figure may be related to the effects of eye-movement. We must combine technical, language, contextual, and programming factors to influence a learner's ability of perception, learning, and memory. We must see and understand the message to learn from it (Petterson, 1989). All processes may be presented as a perceptual cycle (Gale, 1993; Grabinger & Amedeo, 1988; Neisser, 1976; Woods, 1984). In addition, FI learners achieved higher reading scores than FD/FN learners in treatments and field dependence levels (LL/FI, BL/FI). It is considered to be a result of the distribution of subjects in the each category. For the LL/BL category, the high min and max scores were observed and the findings indicate reading abilities and perceptual processing for the each level on the two factors.

Recommendations for future reseach

Previous research results consistently showed field independent students scored significantly higher than field dependent students in similar treatment groups. As noted in previous chapters, field dependence is a continuum between two ends (Dwyer & Moore 1991; 1992; 1994; Moore & Dwyer, 1991; Oltman, 1968). On one end of the continuum, field dependence levels represent different perceptions for creating schema, information and sample by human visual sense. The result of this study showed no significant differences among FDI groups on dependent measures, achievement in WBI, reading comprehension, and reading rate in WBI. There were no significant main effects for the main factors according to Analysis of Covariance (ANCOVA). However, the study found out there was no significant difference on reading comprehension scores using two-way variance analysis (ANOVA) among field dependence levels and lesson types. The result of this study shows there are no significant interactions between factors on dependent measures, achievement on the Web, reading comprehension scores, and reading rate in Web lessons.

To develop lesson sequence strategies and types on the CBI or WBI design, we need clear definition and international agreement for creating user friendly interface design which is based on social and international issues. In addition, human factors in the future software and WEB design should be defined to create new information techniques for presenting in content learning. For this reason, software designers and instructional designers should be aware of differences among learners based on cognitive effects and technological effects to avoid making more mistakes in CBI programs and WEB screens.

As a result, this study may provide considerations for field dependence levels and lesson sequence strategies in the WEB lesson design and CBI lesson design strategies. Lesson sequence design approaches on the computer screen design or Computer-Based Cooperative Instruction (CBCI) systems in WEB design may be important considerations for field dependence, and learning from a WEB program. The study may provide a linking or an interaction for using WEB systems in instructional design process with multimedia lesson design systems for cooperative learning.

Summary of the Study

This study investigated the effectiveness of variations of lesson sequence types and cognitive style of field dependence on the dependent variables, the achievement on learning from WBI program, and N-DRCT scores which includes reading rate of college students at the undergraduate levels. Eighty-seven college freshman students were randomly assigned to the lesson sequence type, after being assigned into three cognitive style groups (FD, FN, and FI). The GEFT was used to determine their cognitive style levels as FD, FN, and FI. cognitive style levels were set as fixed effect factor levels. Treatment groups called linear lesson (LL) and branching lesson (BL) were set as random effect factor levels. With this design, the research analysis was completed according to a fixed effects model of ANOVA and ANCOVA. The study employed a randomized blocks design by assuming three cognitive style blocks of subjects in the experiment as a fixed effect model.

The independent variables (two factors) for the study were the use of lesson sequence types and cognitive style. The reading comprehension scores of the N-DRCT (The Nelson-Denny Reading Comprehension Test) were used as a covariate. Reading scores in computer screen design studies were indicated as a powerful prediction for the students' performance of novice and experienced learners. There was a positive relationship between students' reading scores and GEFT scores and FDI levels, respectively (r= .29; r = .31). The mean differences of dependent measures were analyzed to clarify the main effects by using regression analysis, ANCOVA, and ANOVA. For the prediction model, no interaction parameters for factorial design were checked because of lack of interaction between two factors. Research analysis was done based on these assumptions in a model.

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