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*University of Central Florida*



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THE EFFECT OF COGNITIVE STYLES UPON THE COMPLETION OF A VISUALLY-  
ORIENTED COMPONENT OF ONLINE INSTRUCTION

by

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A dissertation submitted in partial fulfillment of the requirements  
for the degree of Doctor of Education  
in the department of Educational Research, Technology and Leadership  
in the College of Education  
at the University of Central Florida  
Orlando, Florida

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2006

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## **ABSTRACT**

This study was designed to examine whether a person's prepositioned cognitive style influenced learning achievement in a visually-oriented task for an online learning environment in higher education. Field dependence-independence was used to identify individuals' cognitive styles.

A true experimental study was conducted in the fall 2005 term at the University of Central Florida. This researcher followed Dwyer and Moore's research (1991, 2002) and divided learners into three groups (field dependent [FD], field neutral [FN], and the field independent [FI] students). Eighty-three preservice teachers participated in this study; the data from 52 of the FD and the FI participants were analyzed to answer research questions.

The findings in this study supported those in the literature review; students from both FD and FI cognitive styles performed equally well in online learning environments. In addition, for providing introductory-level instruction on visually-oriented tasks in an online learning environment, instructions which emphasized an FD approach benefited both FI and FD students in their knowledge-based learning achievement. In this approach, extra cues and sequence of content might have been the reasons that students had higher scores on their knowledge-based learning achievement and satisfaction levels.

The findings of this study also indicated that students could demonstrate higher performance-based learning achievement if they had more experiences on the subject matter and higher knowledge-based learning achievement if they felt the instructions were easy to follow and the workload of the module was manageable.

Based on the findings and conclusions, the recommendations are: (1) A larger sample size is needed to generalize the findings of the study; (2) In this study, student-to-student and teacher-to-student interactions might affect students' learning achievement. Future studies should consider those interactions as factors and examine their effect on students' learning achievement.

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## **LIST OF ACRONYMS/ABBREVIATIONS**

ACT	Attitudes toward Computer Technology Survey
BAT	Body-adjustment Test
CAS	Computer Attitude Scale
CEFT	Children's Embedded Figures Test
CMI	Computer-mediated Instruction
CSA	Cognitive Styles Analysis
EFT	Embedded Figures Test
FD	Field Dependent
FD/I	Field dependence-independence
FI	Field Independence
FN	Field Neutral
GEFT	Group Embedded Figures Test
MFFT	Matching Familiar Figures Test
RFT	Rod-and-frame Test
RRT	Rotating-room Test
Two-Way ANOVA	A Two-way Factorial Analysis of Variance
UCF	University of Central Florida

## **CHAPTER ONE INTRODUCTION**

M. G. Moore and Kearsley (2005) define the term distance education as "... planned learning that normally occurs in a different place from teaching, requiring special course design and instruction techniques, communication through various technologies, and special organizational and administrative arrangement" (p. 2). One type of distance learning that has gained popularity in recent years is online or Web-based learning. Hirumi (2002) defines online learning as "learning that is facilitated predominately through the use of telecommunication technologies such as electronic mail, electronic bulletin board systems, inter-relay chat, desktop videoconferencing and the World-Wide-Web" (p. 17). Johnson (2003) further elaborates upon it as "...courses that use the World Wide Web as the primary delivery mode. A textbook may or may not be required; all other materials, as well as communication with the instructor, are provided through the course web site..." (p. 53).

Online courses are increasing and expanding in higher education (M. G. Moore & Kearsley, 2005). Based on the surveys from Allen and Seaman's research (2004, 2005), the online enrollment number increased from 1.6 million in 2002 to 2.35 million in 2004. In other words, there were 2.35 million students who had enrolled in at least one online course in 2004. In addition, Allen and Seaman (2005) pointed out that the overall growth rate in online enrollment from 2002 to 2004 was 18.2%. This rate was not only much higher than that in the higher education student population, but also ten times greater than that projected by the National Center for Education Statistics for the general postsecondary student group.

Distance learning has been increasing over the last decade; nevertheless, it also presents some issues. Not every student is successful or possesses the skills required for the distinctive



requirements of online learning. A number of researchers suggest that students have their own cognitive styles (DeTure, 2004; Jonassen & Grabowski, 1993; Reardon & Moore, 1988) and need to learn knowledge or performance skills that address their cognitive styles (Gunter, 2001). Lee and Hirumi (2004) point out that in higher education, identifying students' cognitive styles or needs is one of the essential skills that allows educators to successfully teach online.

Many researchers have conducted various experiments and have identified what types of factors enhance students' learning achievement. Kenny (2002) reported that cognitive styles had a strong influence upon students' pictorial memory. Similarly, Archer (2005) and Frank (2002) found a significant difference between cognitive style and students' learning achievement in online settings. Other researchers, however, found cognitive style did not have a strong relationship with students' learning achievement in general education at a community college (DeTure, 2004), or in a teacher education program at a southeast university (Downing, 2005).

Can cognitive styles or other factors serve as main factors for online learning achievement? Do those factors also have a strong influence on completing visually-oriented tasks in online settings? This researcher adopted guidelines which are suitable for designing instructions to meet learners' cognitive styles based on literature review, and then measured students' learning achievement and other factors by using the designed instructions and other instruments.

### Purpose of the Study

This study was designed to examine the effect of a person's cognitive style on success in visually-oriented components in online environments for a higher education course. In traditional

learning environments, cognitive styles have been examined in a variety of ways; however, this kind of study was still rare in online learning environments, especially for the visually-oriented tasks. This study was designed to examine if educators could design visually-oriented instructions based on students' cognitive styles and enhance learners' learning achievement in online learning environments of higher education.

### Research Questions

Based on the literature review, cognitive style might or might not affect students' learning achievement in online learning environments, especially for a visually-oriented component in higher education. For this study, this researcher focused on an experimental study with the following questions:

- A. Is there a significant difference in students' learning achievement based on their cognitive styles and treatments?
- B. Is there a significant difference in students' attitudes toward computer technology based on their cognitive styles and treatments?
- C. Can students' learning achievement be predicted from their cognitive styles, treatments, prior knowledge, attitudes toward computer technology, online learning experiences within the module, or any combination of these factors?
- D. Is there a significant difference in students' satisfaction levels based on their cognitive styles, treatments, prior knowledge, or any combination of these factors?

## Hypotheses

In order to answer these research questions, this researcher stated statistical hypotheses as follows:

- A. In online learning environments, there will be a statistically significant difference in the learning achievement between students who received instructions based on their cognitive styles and those who received instructions not based on their cognitive styles (*field dependence and field independence*).
- B. There will be a statistically significant relationship in students' learning achievement and students' cognitive styles, treatments, prior knowledge, attitudes toward computer technology, online learning experiences within the module, or any combination of these factors.
- C. There will be a statistically significant difference in students' attitudes toward computer technology among students who have different cognitive styles (*field dependence and field independence*) and are in different treatment groups.
- D. In online learning environments, there will be a statistically significant difference in students' satisfaction levels between students who received instructions based on their cognitive styles and those who received instructions not based on their cognitive styles (*field dependence and field independence*).

A research method was described in Chapter Three based on the findings from the literature review and procedures identified in the pilot study.

## Limitations of the Study

The interpretation of results from the study was based on the following assumptions and limitations:

- The result of GEFT and other measurements used in this study assume that students answered all questions independently and honestly, which this researcher reminded students to do before each measurement in the instructions.
- Even though the module was designed as an online instruction, the EME 2040 course was a Web-enhanced course. The participants met with their instructors at the class meeting time every week except during the experiment period. Therefore, students' learning behaviors might not be the same as those in totally online courses.
- This module was provided at the later part of the course schedule. Students might have created their physical and social relationships with their peers; the isolated learning environment that online students normally faced might have not affected our participants. The isolation feelings, however, might have affected the participants more because the modality adopted in this experiment.
- Gender in this study was not balanced. The ratio of male participants to female participants in this study was about 1 to 3. In addition, male students normally are 10% of the population in the college of education. The sample also represented the gender rate in the population.
- The treatments only had expert validity because they were designed to meet the needs of the study. However, these treatments were also modified based on the feedback of

participants in the pilot study. These processes were used to make sure the rigor of this study.

- Small sample size (82 participants) might be the reason that many factors did not have a statistically significant difference in this study.
- The conclusions were limited to the population presented by the sample and to the modality of online instructions of the study. Generalizations of the outcomes in this study to other populations should be made with caution.

### Significance of the Study

The results of this study can contribute to the instructional design and teacher education fields. These contributions are described below.

Research for cognitive styles in online learning environments, especially for visually-oriented tasks, is rare today. Therefore, this study was not only designed to explore the essential elements for students to successfully complete a visually-oriented task in the WebCT environment in higher education, but also designed to examine the relationship between cognitive styles, specifically field dependence-independence, and students' learning achievement. This research will help educators make better decisions about whether or not to develop and implement their online instructions based on learners' cognitive styles. In addition, it will help researchers examine the similarities and differences of effects of cognitive styles or other factors such as students' prior knowledge, attitudes toward computer technology, online learning experiences within the module, and satisfaction levels between traditional and online learning environments in higher education.

Today, it is very important to help teachers update their knowledge about integrating and applying suitable technology or media into their curriculum (Gunter, 2001). Elwes (2005) indicated that video is the “default” or “mainstream” medium in this century (p. 1). The video-editing module was designed as the treatment in this study and the sample of preservice teachers was selected to represent the teaching population. The findings of this research will help administrators make better decisions about providing courses involving visually-oriented tasks in online settings. In addition, by examining students’ learning achievement and satisfaction levels, the administrators can make better projections about the future markets for providing similar online courses as alternatives for preservice or even inservice teachers.

## Definition of Terms

### *Cognitive Styles*

Chinien and Boutin (1993) defined cognitive styles as “...the information processing habits representing the learners’ typical mode of perceiving, thinking, problem solving, and remembering” (p. 303). These kinds of aptitudes have been shown to remain stable over time. Field dependence-independence (FD/I) was the cognitive style used in this study. This researcher followed Dwyer and Moore’s research (1991, 2002) and identified participants as learners who are field dependent (FD), field neutral (FN), or field independent (FI). Therefore, FD, FN, or FI learners represent the learners who are field dependent, field neutral, or field independent.

### *Visually-oriented Component*

Visuals are icons that resemble the thing they represent. In educational instruction, the visual component can involve text, graphics, video program, animation, etc. (Heinich, Molenda, Russell, & Smaldino, 2002). In this study, visually-oriented components or tasks referred to the instruction which involved graphics and video clips. This study used graphics and video clips to demonstrate video-editing instructions and required students to complete activities, assignments, and tests which included video clips.

### *Population of Participants*

The participants were eighty three students from three sections of EME 2040, Introduction to Educational Technology. This course was offered by the College of Education, University of Central Florida (UCF). The main purpose of this course was to prepare preservice teachers as qualified computer-based specialists. They learned how to integrate and apply suitable instructional technology into their teaching strategies in the future (Gunter, 2001).

### *Web-enhanced Courses*

There are different modalities in online learning environments. At UCF, there were three modalities: Web-enhanced, Mixed, and World Wide Web courses (Dziuban, Hartman, Moskal, Sorg, & Truman-Davis, 2004). C. D. Dziuban et al. defined that Web-enhanced courses "...are fully face-to-face course offerings that include a substantive required online component; for example: online course materials; links to other course-related Websites; use of computer-mediated conferencing, email or chat facilities; and online testing" (p. 2). For this study, the

treatment, a video-editing module, was put in WebCT and the students were required to complete all treatment activities in this environment.

Today, many instructors design their curriculum and interact with their students via WebCT and do not reduce class attendance at UCF, no matter if their courses are listed as Web-enhanced courses or not. Therefore, Center for Disturbed Learning, a unit to regulate all policies and provide administrative support of distance education at UCF, only defines online courses that reduce class attendance partially or totally as two types: Mixed mode, reduced seat time courses and World Wide Web courses (University of Central Florida, 2005). The definitions are as follows:

**Mixed-Mode, Reduced Seat Time courses** include both required classroom attendance and online instruction. These classes have substantial content delivered over the Internet, which will substitute for some classroom meetings.

**World Wide Web courses** are conducted fully via Web-based instruction and collaboration. Courses may require proctored examinations, and may include opportunities for face-to-face orientations, but there will be no class attendance requirements (University of Central Florida, 2005).

### *Learning Achievement*

Gay and Airasian (2003) described an achievement test that was designed for obtaining information about how well students had learned in a school setting. In this study, the participants were assessed before and after the treatment, and their learning achievement was



measured by their Pretest and the Posttest scores. The treatment was a video-editing module in an online learning environment (WebCT).

### *Satisfaction Levels*

In order to identify participants' satisfaction levels for the study, these levels were measured by two Likert scale questions in the questionnaire. The questions were related to how they felt about they gained knowledge skills and performance skills of the subject matter after competing the module. Thus, this researcher had a better understanding of the participants' satisfaction levels in this study.

## CHAPTER TWO LITERATURE REVIEW

### Cognitive Styles

Chinien and Boutin (1993) defined cognitive styles as “the information processing habits representing the learners’ typical mode of perceiving, thinking, problem solving, and remembering” (p. 303). Gagne (1985) also stated that “...skills by means of which learners regulate their own internal processes of attending, learning, remembering, and thinking” (p. 55). These kinds of internal processes were mirrored in a way that allowed learners to construct a generalized approach to learning (Riding & Rayner, 1998) and were stable enough to allow learners to continue the same behavior over time (Manning, in Wapner & Demick, 1991).

In 1991 there were over 7000 studies related to cognitive styles or learning styles (Frazier, 1991). A number of researchers were using different terminology to express the same phenomenon. Cassidy (2004) pointed out that previous research mixed the terms of “cognitive style,” “learning style,” and “learning strategy” frequently in theoretical and empirical dimensions of the topic. Other researchers used those terms interchangeably. A number of researchers like Riding and Sadler-Smith (1997), however, argued that cognitive style “...is much more pervasive, stable, and deep seated than learning style” (p. 200). Learning style was adopted to present a concern with the application of cognitive style in a learning environment (Riding & Cheema, 1991), and learning strategy was the method learners select to handle different tasks (Hartley, 1998). On the other hand, researchers like James and Gardner (1995) argued that learning styles were more acceptable in research and had a broader meaning than

cognitive styles. Unfortunately, this debate about terminology still exists in this field (Cassidy, 2004).

In this study, this researcher uses the term “cognitive style” as defined by Chinien and Boutin (1993) to represent learners’ typical habits of perception and interaction in learning environments. These habits are stable and remain over time. In addition, the behaviors are more deeply seated than learning styles (Riding & Sadler-Smith, 1997).

Many studies have been conducted in cognitive styles since the early 1940s. Curry (1983, 1987) proposed an “Onion” model to present different perspectives on cognitive styles and the degree which they could be influenced or impacted. In 1983, she grouped them into three layers and extended them to four layers in 1987 to resemble the layers of an onion:

**Instructional preference:** Curry examined instructional preferences and placed them in this layer. This layer was described as relatively observable, unstable, and influenced. Influences included learning environments, instructor and learner expectations, and other external factors.

**Social interaction:** This was the new layer extended by Curry in 1987. She examined individuals’ preferences for social interaction in a learning environment and placed them next to the layer of instructional preference.

**Information processing:** Curry examined an individual’s intellectual approach to dealing with information processing and placed them in this layer. She also positioned seven main learning style theories like Kolb (1984) ELM, Honey and Mumford (1992) LSQ, or Vermunt (1994) LSI here. This layer was described to be more stable than the previous two layers because it was not directly affected by the environment, but it was adjustable by learning strategies. The styles in this layer were described to be influenced by the inner layer of cognitive personality

style. Curry also thought that they affected the outer layers of instructional preference and social interaction.

Cognitive personality: Curry examined an individual's approaches to adapting and processing information and placed them in this layer. The layer was described to be relatively permanent to the personality dimension. A number of cognitive styles were discussed here, such as FD/I (Witkin, Oltman, Raskin, & Karp, 1971, 2002); Holist-serialist thinking (Pask & Scott, 1972); and Matching Familiar Figures Test (Kagan, 1964).

Curry's (1983, 1987) classification supports the proposition that learners' motivation, cognitive styles, and learning achievement are associated. This classification also has influenced the application of metacognitive skills such as situation analysis and self-evaluation to enhance students' learning performance (Shih & Gamon, 2001).

In recent years, the Cognitive Styles Analysis (CSA) style (Riding, 1991) has been used in computer, hypermedia, or distance learning environments. Atkins, Moore, Sharpe, and Hobbs (2001) and Price (2004) examined different cognitive styles and also categorized CSA into the cognitive personality layer. The four main cognitive styles in this layer are described below.

#### *Field dependence-independence*

Field dependence-independence (FD/I) was initially identified by Witkin and Asch (Riding & Cheema, 1991; Witkin & Asch, 1948). Riddle (1992) stated FD/I not only has a strong theoretical framework, but also a proven connection to several psychological phenomena and functions that researchers initially believed to be unrelated. He further explained that FD/I "...can be attributed in part to its breadth and to its real visible manifestations in everyday life"

(p. 2). In addition, Riddle thought that this approach was effective and easy to measure.

Therefore, FD/I received significant attention and became one of the most extensively researched topics in the instructional technology research area (Anderson & Reed, 1998; Ayersman & Von Minden, 1995; Chen & Macredie, 2002; Pi-Sui-Hsu & Dwyer, 2004).

Field dependence-independence research originally began at laboratory studies during World War II because Witkin and his co-researchers tried to understand individual differences in their “perceptions of the upright” (Witkin & Goodenough, 1981). These experiments unexpectedly found that participants were functioning quite differently from one another but were self-consistent in performing assigned tasks. Witkin and his co-researchers used the body-adjustment test (BAT) which was the first assessment to test field-dependency, the rod-and-frame test (RFT), and the rotating-room test (RRT) to measure whether participants would rely on external results of visual framework in a different location of upright or the gravitational upright that their body experienced (Witkin & Goodenough, 1981). The experiments focused on the relationship between participants’ visual or kinesthetic hints and the levels of dependence on the visual environment presented (Riding & Rayner, 1998).

During the later years, additional assessments of field dependence-independence were developed to include more variations beyond the original tests. Assessments also moved from laboratory experiments to a paper and pencil instrument, the Embedded Figures Test (EFT) (Witkin, 1950), which required participants to identify and draw a specific shape from a complex figure. This test did not involve body-field combination or perception of an upright body as previous assessments did because they found participants who had difficulties in separating a simple figure from a complex design were the ones who relied on external results of visual

environments presented (Witkin & Goodenough, 1981). Today assessment instrument has two modified versions:

Group Embedded Figures Test (GEFT): a group-administered test for adults or participants over a broad age range. It is similar to EFT but designed for group use. It has 25 test items in three separate sections (Witkin et al., 1971, 2002). Furthermore, GEFT is the most commonly used instrument to identify FD/I (Chen & Macredie, 2002; Gibbs, 1999).

Children's Embedded Figures Test (CEFT): an individually-administered test for children in the five-to-ten-year age range. It had 25 test items. This version, however, has not been available since 2002 (Witkin et al., 1971, 2002).

Experiments using this assessment technique have been reported in the literature since 1970 (DeTure, 2004). For instance, McKenna (1984) reported that there were more than 3,000 studies related to FD/I area only before 1980. That research focused on factors that affected learners' perception and interaction with instructional setting, media, and methods. Riddle (1992) stated that FD/I "...is a capacity to overcome or analyze embedded contexts in perceptual functioning. Field dependent and field independent participants differ in how they perceive the difference and not in how accurately they perceive" (p. 3).

Researchers have identified several characteristics between field dependent (FD) and field independent (FI) learners and how they perceive and interact with the learning environment. For example, Jonassen and Grabowski (1993) stated that FD learners are more likely to be affected by the learning environment and more easily accepted structure or idea of instructions presented. They have difficulty with accepting instruction which is less structured or not organized. They need guidance or help from the instructor, peers, or relevant cues and standards from instructions to make judgment, especially for the higher order thinking skills (Pi-Sui-Hsu &

Dwyer, 2004). They are sociable, like to work in groups, and tend to have better learning achievement on specific subjects like psychology, sociology, or counseling (Ikegulu & Ikegulu, 1999; Riddle, 1992). They are likely to rely on visual cues (Riddle, 1992).

On the other hand, field independent learners are more likely to construct their own knowledge by selecting information from the learning environment. Some research has supported that they would like to receive less structuring aids than FD learners do (Riddle, 1992; Witkin, Moore, Goodenough, & Cox, 1977). They are not easily influenced by the social cues, and they like to have distance in social relations. In addition, they are more abstract oriented and would like to express concepts via analysis (Riddle, 1992). FI students are usually found to perform better than FD students in schools as well as criterion tests in traditional learning settings (Wilson, 1998). A number of researchers (Palmquist & Kim, 2000; Whyte, Karolick, & Taylor, 1996) examined literature and stated that FI students tend to have better learning achievement on math, science, engineering, and computer related areas.

The results of GEFT describe an individual's cognitive style tendency; a higher score indicates the learner's tendency toward field independence, and a lower score indicates the learner's tendency toward field dependence. Therefore, a number of researchers used this instrument but identified participants as belonging one of three groups – field dependent, field mixed (Liu & Reed, 1994) – also called field neutral (FN) (Dwyer & Moore, 1991), and field independent. The terms field mixed or field neutral refer to an individual who does not have a strong tendency toward either field dependence or field independence. In this study, this researcher identified participants into three groups (FI, FD, and FN) but only analyzed the difference between FI and FD participants because FN participants did not have a strong tendency toward field dependence or field independence.

### *Holist-serialist Thinking*

This dimension of cognitive styles was first introduced by Pask and Scott (1972). It includes two abilities that represent an individual's inclination toward a learning task: one adopts a global strategy or is hypothesis-oriented; the other adopts a step-by-step process or is data-oriented (Riding & Rayner, 1998). The holists deal with information by seeking the trends or key patterns first; they focus on the learning task as a whole. On the other hand, the serialists deal with information by choosing one part at a time and moving to another part after understanding the previous one. They focus on developing links between each learning task (Cassidy, 2004).

The instrument for this cognitive style is a series of problem-solving tasks developed by Pask and Scott (1972). Learners who use a step-by-step approach to solve the task are classified as serialists, and those who try to adopt a quick solution by examining more complicated hypotheses are classified as holists. Pask (1988) pointed out that holists are characterized as making rushed decisions from insufficient information, and serialists are characterized as having difficulty dealing with things in a global view because they have a narrow focus and are cautious.

This instrument has been criticized because it is complicated and time-consuming. In addition, according to some researchers, the instrument measures learners' information-process strategies more than styles (Jonassen & Grabowski, 1993; Riding & Cheema, 1991). Riding and Rayner (1998) also stated that this dimension only relies on the sample with a small range in population and lacks empirical evidence to examine the association with other cognitive styles. However, Pask (1976) did state that this dimension might have some links with the convergent-divergent dimension of cognitive style; holists received a better performance on the Analogies Test and Divergence Test than serialists.



### *Matching Familiar Figures Test*

Matching Familiar Figures Test (MFFT) was developed by Kagan (1964) and is used to measure an individual's impulsivity-reflexivity dimension of style. Learners who make a quick response and identify the correct drawing after scanning several possibilities are classified as "cognitive impulsives," and those who examine every possibility before making their final decision are classified as "cognitive reflectives" (Cassidy, 2004). Even though MFFT has been treated as the basic research instrument of cognitive styles, it has been criticized because of its problems. For example, according to one group of researchers, its scoring procedure does not present learners along a continuum which should range from long response time to short latencies and from incorrectness to accuracy (Ault, Mitchell, & Hartman, 1976). In addition, this test does not provide normative data. Participants can be classified as reflexive in one group and impulsive in another group (Buela-Casal, Carretero-Dios, De los Santos-Roig, & Bermudez, 2003). Another problem is that MFFT has low internal consistency reliability (Ault et al., 1976). Therefore, to correct the internal consistency issue, there are several additional instruments to measure the impulsivity-reflexivity dimension of style. The MFFT, however, is still the most extensively adopted instrument in research (Riding & Rayner, 1998).

Matching Familiar Figures Test is an individually-administered test; it takes about 15-20 minutes to complete. The test includes twelve measure tests, each has eight alternative choices. This instrument mainly focuses on child development and is used for measuring the degree that an individual makes decisions under uncertain problems (Buela-Casal et al., 2003; Riding & Rayner, 1998). One interesting finding is a considerable relationship between impulsivity-

reflexivity and FD/I (Banta, 1970). Researchers like Schleifer and Douglas (1973) reported that impulsivity is similar to field dependence, and reflexivity is similar to field independence.

### *Cognitive Styles Analysis*

Cognitive Styles Analysis is a well-known computerized instrument used to measure an individual's position in the wholist-analytic and the verbaliser-imager scope. Its origin can be traced to Riding and Cheema (1991) who examined cognitive styles from literature review and identified them as being one of two groups: whole-analytic and verbal-imagery scopes. The wholist-analytic scope presents internal cognitive processes. This scope presents the way an individual constructs and arranges information: wholists view or construct information from the global perspective; analytics, on the other hand, view or construct information from its component parts (Riding & Sadler-Smith, 1997). The verbaliser-imager scope explains the degree to which individuals are inclined to express or deal with information in words (verbaliser) or in images (imager) (Cassidy, 2004). Riding and Cheema pointed out that these two scopes of cognitive styles exist independently, and a verbaliser or an imager can be placed at either end of the wholist-analytic scope. Riding (1991) later developed the Cognitive Styles Analysis (CSA) instrument to integrate and measure the two scopes.

This instrument is designed to measure an individual's inclination to think verbally or visually, and deal with information wholistically or analytically (Riding & Rayner, 1998). It includes three subtests. The first subtest measures the verbaliser-imager style, the second subtest measures the wholist dimension of style, and the third subtest measures the analytic dimension of style. The test targets range from child to adult and across culture and discipline. This instrument

usually takes 10 minutes to complete and the program automatically grades learners' final results (Riding, 1991). Riding claimed that one of CSA's advantages is that this instrument can positively locate learners' cognitive styles based on their separate subtests. In addition, this method can also avoid the criticism of the GEFT instrument that a low score can be interpreted either as the learner is really a FD or that the learner is an FI learner with low motivation or a visual obstacle.

The CSA has been utilized in traditional learning environments (Emmett, Clifford, & Gwyer, 2003), computer-mediated or computer-based instruction, online searches (Ford & Chen, 2000, 2001; Graff, 2003, 2005), and computer-mediated conferencing (Cunningham-Atkins, Powell, Moore, Hobbs, & Sharpe, 2004). It has received substantial empirical evidence (Atkins et al., 2001).

### *The Critics*

Riding and Rayner (1998) examined and reported a review with over 30 different styles labeled. They, with other researchers, also found that most styles simply expressed the different perspectives of the same dimensions (Brumby, 1982; A. Miller, 1987). For example, Price (2004) argued that the characteristics of CSA are similar to those in the FD/I approach, but add other styles like impulsivity-reflectivity, holist-serial, and diverging-converging. Other researchers report that the Matching Familiar Figures Test is also associated with FD/I (Banta, 1970; Schleifer & Douglas, 1973).

Even though Riding and Cheema (1991) claimed that FD/I belonged to wholist-analytic groups, Emmett, Clifford, and Gwyer (2003) reported a contradictory result. Emmett et al. used

both CSA and GEFT to measure learners' context reinstatement and memory performance. The results from two instruments were not similar and even opposite in some situations.

Some researchers criticized the validity of FD/I approach and the EFT. For example, a number of researchers argued this approach generalizes performance on perceptual tasks to personality and social behavior and that this is an over-dilatation of the theory (Griffiths & Sheen, 1992). Another common argument is that the approach and the test are designed to measure learners' intelligence or psychological capabilities other than cognitive styles (McKenna, 1984, 1990; Richardson & Turner, 2000; Riding & Rayner, 1998). In fact, many cognitive styles theories are also criticized in a similar way (R. E. Clark & Feldon, 2005; Curry, 1990). Riding and Rayner (1998) pointed out that low scores on GEFT may be attributed to other factors like low learner motivation or visual obstacles. Nevertheless, they are classified as FD learners in this approach. As such, FI learners often perform better, and this cognitive style is easy to connect to intelligence. Messick (1984) argued that cognitive styles measure more dimensions than intellectual abilities, and cognitive styles are typically bipolar but abilities are normally unipolar. In addition, a number of researchers argued that the relationships between cognitive styles and intelligence or other psychological capabilities are extremely negligible and lack empirical evidence (Ausburn & Ausburn, 1978; Cassidy, 2004). Riddle (1992) also stated that FD/I "...is a process variable describing ways of orienting and functioning and not the success in attaining goals..." (p. 3). Sternberg (1997) also stated that these arguments cannot diminish the value of FD/I. On the contrary, Sternberg (1997) stated that these arguments show that FD/I has value not only in visually complex areas, but also in measuring psychological ability like spatial competence.

For preventing visual obstacle problems, GEFT provides practice items in the first section. In addition, learners' grades are not counted as valid if the learners failed any practice item (Witkin et al., 1971, 2002). In order to prevent confusion with intelligence ability, many researchers still suggested controlling the intelligence variable for conducting the experiments between cognitive styles and other factors (Ausburn & Ausburn, 1978; Rosenberg, Mintz, & Clark, 1977).

### Distance Education

Today's learners face the reality that they need to learn not only in their school years, but also during their career periods. They may have more than one career or need to maintain their skill set in one field. Ordoñez and Ramler (2004) pointed out that formal education requires family commitment and presents many challenges for learners. In order to meet learners' needs for lifelong learning in today's society, alternatives should be considered in higher education, and distance learning is one of them.

Schlosser and Simonson (2005) defined distance education as "institution-based, formal education where the learning group is separated, and where interactive telecommunications systems are used to connect learners, resources, and instructors." (p. 1) M. G. Moore and Kearsley (2005) further elaborated "Distance education is ... requiring special course design and instruction techniques..." (p. 2).

These definitions point out that the characteristics of distance education allow students to interact with instructors, instruction, and learning environments via technology. It is not necessary to meet their instructors face-to-face for learning. In addition, the learning process is

more learner-oriented and more flexible than traditional learning. Distance education is institution-based and is involved with curriculum plans, resources, and services to their students.

The development of distance education can be identified by two periods: correspondence study and electronic communications (Schlosser & Simonson, 2005). Other researchers utilize five generations: correspondence study, broadcasting, a systems approach such as open universities, teleconferencing, and computer or Web-based learning (M. G. Moore & Kearsley, 2005). Web-based learning has developed since the late 1990s. Johnson (2003) defined it as "...courses that use the World Wide Web as the primary delivery mode. A textbook may or may not be required; all other materials, as well as communication with the instructor, are provided through the course web site..." (p. 53). According to Johnson, this new experience impacts higher education more than any other instructional delivery method (Johnson, 2003). Other researchers stated that Web-based learning has become a primary delivery mode in distance education (M. G. Moore & Kearsley, 2005; Waits & Lewis, 2003).

Even though Web-based learning uses World Wide Web as the primary delivery mode, there are three main modalities in higher education: online mode, blended/hybrid mode, and web facilitated mode (Allen & Seaman, 2005). The main difference among these modalities is students' class attendance requirement. Online mode courses are held completely online and have no class attendance requirement. The instructors may provide in-class exams or extra face-to-face meeting time. Blended/hybrid mode courses are mixed with online and face-to-face instructions. Furthermore, online instructions can reduce class attendance time. Web facilitated mode or Web-enhanced (Dziuban et al., 2004) courses are mainly face-to-face courses. The instructions, however, use WebCT or other online management courseware to provide

supplemental information such as the syllabus, useful online resources. The Web-enhanced mode courses do not reduce class attendance time (Dziuban et al., 2004).

Instructors who had online teaching experience in higher education felt that online settings lacked visual cues (Bower, 2001; Smith, Ferguson, & Caris, 2003). These instructors, on the contrary, also felt that their instructions were more explicit (Coppola, Hiltz, & Rotter, 2002; Pyle & Dziuban, 2001), their feedback was more appropriate and creditable (Coppola et al., 2002), and their students were more interactive and participative (Coppola et al., 2002; Gold, 2001; Hartman, Dziuban, & Moskal, 2000; McIsaac, Blocher, Mahes, & Vrasidas, 1999). From students' points of view, they also felt that their study time was more flexible (Johnson, 2003; Shih & Gamon, 2001) and learning activities were more engaging and fulfilling (Chou & Liu, 2005; Shokar, Bulik, & Baldwin, 2005). In addition, new technology like instant messengers and video conferencing also reduced psychological and communication gap between learners and instructors (Johnson, 2003).

Lee and Hirumi (2004) identified the essential characteristics of a successful online educator based on literature review from 1994-2004. A competent distance educator should not only master his or her content area, but also be good at interaction, management, technology, and teamwork skills. In addition, he or she needs to organize instructional materials and activities clearly and well, to identify students' learning styles or needs, and to provide a variety of learning activities based on learners' styles or needs.

Distance education provides flexibility to the learners; however, it also produces some challenges. For example, students need to know how to navigate online instructions and adapt to the self-directed online environment (DeTure, 2004). Even though a number of researchers, such as Kravitz (2004), admitted that learners today have better web navigation skills than they do,

they still claimed that instructors or instructional designers should not assume learners can navigate in Web-based learning environments effectively (Chen & Paul, 2003). In addition, institutions should provide appropriate support systems such as user-friendly courseware, orientation workshops, or help desk services to help learners to overcome the navigation problem (Sorg et al., 1999; Truman-Davis, Futch, Thompson, & Yonekura, 2000). Another challenge is that online instruction with many links to related Web sites might provide more cognitive load than traditional and linear learning environments (Palmquist & Kim, 2000). Lee and Hirumi (2004) examined relevant literature and found that the instructional design effort for online instruction was a critical process. Proper design provided suitable learning load and resulted in instruction that enabled students to be self-directed in the online learning environment.

The relationship between FD/I approach and distance education in higher education can be found since the 1970s. Moore, M. (1977) found that FD/I could be used as a predictor in distance learning environments, and FD learners were more attracted to the environment which was less distant. Some researchers found that in distance learning environments, learners were required to be more independent and self-directed; these characteristics were not suitable for the nature of FD learners, and it was the reason that FD learners usually did not perform better than FI learners (Keegan, 1990; Luk, 1998). There were a number of studies, however, like Shih and Gamon (2001), who reported that their participants were mainly FI learners, but there was no significant difference between learners' cognitive styles and learning achievement in a Web-based learning environment. They also concluded that learners who are FD and FI could learn equally well in this kind of environment. Similarly, Miller (1997) argued that distance education does not favor FI learners only; instead Miller stated the key point should be focused on how researchers and educators design their instruction to stimulate the interactions between students



and contents, students and teachers, and students and students as well as how institutions provide support to meet FD learners' needs.

### The Impacts of FD/I on Instructional Design, Teaching or Learning Strategies

Cognitive styles impact how learners learn, how instructors teach, and how learners and instructors interact in the learning environment (Chen & Macredie, 2002; Kogan, 1971). Many researchers suggested incorporating cognitive style elements into instruction. For example, Ehrman (1990) stated that FD/I can "...make a major contribution to sophisticated learner counseling, not only on learning strategies but also on affective matters" (Ehrman, 1990, p.19). Other researchers stated that FD/I provides a broader profile of learners beyond their intelligence, aptitude test score, and grade average (J. Keefe, 1987; Messick, 1984). Ragan et al. (1979) emphasized that "individuals may encounter tasks that require processing of information in a way that they are unable to accomplish, simply because their cognitive style restricts the availability of the processing technique" (p. 2). Keefe (1982) pointed out that the key to effective instruction is to "understand the range of student learning styles and to design instruction and materials that respond directly to individual learning needs" (p. 43). Chen and Macredie (2004) urged that educators provide appropriate instruction based on learners' cognitive styles to help learners overcome information processing difficulties. Similarly, Riding and Sadler-Smith (1997) as well as Hayes and Allinson (1996) stated that cognitive styles play an important role in determining learning performance or achievement. Instruction that is designed using cognitive style strategies will improve students' learning achievement, reduce study time, and enhance students' attitudes toward learning (Chinien & Boutin, 1993).

Cognitive styles not only affect how students learn, they also affect how instructors teach (Garlinger & Frank, 1986). Witkin et al. (1977) provided evidence that instructors designed their instruction and conducted activities related to their teaching preferences and behaviors. FD instructors would likely involve more interactive activities and build a warm and personal environment. On the other hand, FI instructors would likely provide a teacher-directed learning environment in which the instruction was more organized, but with less interactive activities. Based on a meta-analysis study by Garlinger and Frank (1986), learners usually presented a slightly higher level of achievement when learners and their instructors were on the same style of FD/I. These researchers, however, also pointed out that FD students sometimes would fail to support this evidence. The reason for this might be that FD instructors were not capable of providing the structured instruction that FD learners needed.

By examining the empirical evidence, this researcher did not reach a definitive conclusion about how cognitive styles influenced students' learning achievement and instructional strategies. For example, several researchers reported that FI students performed better in hypermedia (Angeli & Valanides, 2004; Leader & Klein, 1996) and Web-based learning environments (Frank, 2002). A number of researchers (Riddle, 1992; Weller, Repman, & Rooze, 1994) who examined the literature review also found FI learners exhibited more variance in their approach and achievement than FD learners when instruction was manipulated and when the interaction between cognitive styles and treatments was significant.

Leader and Klein (1996) reported that if the hypermedia system provided functions for assisting nonlinear navigation and analytical searches, FI learners could perform better than FD learners. On the other hand, a number of studies also reported that FD learners could improve

their scores if the instruction accommodated their learning styles (Palmquist & Kim, 2000; Pi-Sui-Hsu & Dwyer, 2004).

The results of a number of studies showed that FI learners obtained higher learning achievement no matter which treatment they received. This phenomenon had also happened in traditional (D. M. Moore & Dwyer, 1994; Worley & Moore, 2001) and hypermedia learning environments (Angeli & Valanides, 2004; Luk, 1998; Weller et al., 1994).

On the contrary, findings in other studies supported that FD/I could be a poor predictor of students' learning achievement (R. E. Clark & Feldon, 2005). For example, in a traditional learning environment, there was no statistical significance in students' learning achievement regardless of treatments, cognitive styles, and the interaction between them (Macneil, 1980). In CMI or distance learning environments, similar conclusions were found (Brenner, 1997; Buck, 2005; DeTure, 2004; Shih & Gamon, 2001).

A number of researchers stated that they did not find a difference in learning achievement between FD and FI learners. However, they did find differences in learners' learning approaches (Chen & Macredie, 2002, 2004; Wapner & Demick, 1991). These findings also raised several questions related to the educational implications in FD/I. These questions included how different instructional approaches accommodated the individual learning differences between FD and FI learners. One popular research area was that in which instructors utilized teaching strategies based on the differences among each type of learner, and then measured if there was any interaction between learners' style tendencies and the treatment (Chen & Macredie, 2002; Riddle, 1992). This research area also disclosed the importance of the relationship between learners' learning styles and instructional methods.

In a traditional environment, a number of researchers found that FD and FI learners were not different in their learning when the instruction was fully structured; however, if the instruction was not organized well, FD learners would have difficulty in learning those materials because FD learners construct their knowledge by following the sequence of the material presented. On the contrary, FI learners seem to have a higher tolerance for instruction that is not organized well because they can usually construct their knowledge in their own way (Luk, 1998; Pascal, 1973).

In hypermedia learning environments, researchers such as Palmquist and Kim (2000) reported that FD learners, especially beginners, were inclined to navigate in hypermedia environments in a linear way. They often used the home and back buttons or embedded links to learn information. In addition, users clicked on the home button usually to imply that they were easily disoriented in this environment and wanted to start over. Therefore, the characteristics of FD learners working within an online setting were that they were easily disoriented and followed the instruction as it was presented. These characteristics were consistent with those found of FD learners in traditional learning environments. However, Palmquist and Kim also found that FD learners could be trained to overcome their disorientation in hypermedia learning environments if the instruction provided novice FD learners with some tools such as a history list or navigation map. Their findings also showed that experienced FD learners took the same amount of time as FI learners during an online search. Chen and Paul (2003) also pointed out that disorientation and extra support were the critical issues in Web-based instruction; however, the effectiveness of those extra cues relied on instructional characteristics. Therefore, more empirical evidence is needed.

Liu and Reed (1994) conducted a study to measure whether instruction that incorporated FD/I cognitive styles could enhance students' vocabulary learning in hypermedia environments. Even though the cognitive styles did not affect learner's learning achievement, a significant relationship between learners' cognitive style and their use of a hypermedia setting was found.

Chen and Macredie (2002) examined 30 quantitative and qualitative studies related to FD/I and hypermedia environments published from 1989 to 2001. They found five core themes that were most common in the literature review: nonlinear learning, learner control, navigation in hyperspace, matching and mismatching, and learning effectiveness. They also developed a learning model to illustrate FD and FI learners' characteristics and learning patterns and provided instructional strategies to meet FD and FI learners' needs in hypermedia learning environments. They conducted an experiment to provide an html introduction module in a Web-based learning environment (Chen & Macredie, 2004); the instruction was designed based on the model they developed. The participants had statistically significant differences in their preference for the Web-based learning settings; students preferred the instructional design that matched their cognitive style.

A number of researchers, on the other hand, stated that instructors should allow learners to explore different kinds of teaching or learning strategies in order to meet the needs of today's society (Ehrman, 1990; Shipman & Shipman, 1985; Thompson & Knox, 1987). Robotham (1999) suggested that researchers or educators provide instruction with respective cognitive styles in introductory courses to help learners establish essential foundations, or provide such instruction for novice learners to build their confidence. Verduin and Clark (1991) also reported that adult learners might or might not learn effectively when instruction matched their learning styles. Nevertheless, learners felt more satisfied when the instruction matched their cognitive styles. For

advanced courses or learners, Robotham (1999) suggested that researchers or educators provide instruction with varied teaching strategies to stimulate learners' potential for other possibilities. He further stated that in higher education, the main task of educators is to facilitate students to become self-aware and self-directed learners. This should go beyond specific instruction or objectives.

Based on the research results above, it is still not easy to make a definite conclusion about how FD/I impacts instructional treatments and students' learning achievement. Therefore, more studies are needed in this field (Angeli & Valanides, 2004; Davis, 1991).

### *The Critics*

A number of researchers claimed that cognitive styles can affect teaching and learning in four areas: instructional design (Ausburn & Ausburn, 1978; Chen & Macredie, 2004; J. W. Keefe, 1982; Wilson, 1998); teaching strategies (Garlinger & Frank, 1986; Riding & Sadler-Smith, 1997; Witkin et al., 1977); assessment methods (Wilson, 1998); and learner support (Riding & Sadler-Smith, 1997). A number of researchers like Curry (1990), however, argued that this field has three main problems, and they are as follows.

First, definition is not clear. The concept, scale, and scope of learning styles or cognitive styles are quite vague. Even the definition for operation is varied. Therefore, it is not easy to define style, strategy or tactic from their studies.

Second, reliability and validity evidence are not supportive. Researchers such as Clark and Feldon (2005) as well as Curry (1990) claimed that most researchers did not specify the conception and assessment that meet minimum criteria for use and analysis. Those researchers

just rushed to publish their results based on a small dataset. Participants usually were unaware of the difference between the instrument they took and other similar instruments. Additionally, instrument developers in cognitive styles seldom provided enough information for their reliability results as well as style classification decisions (R. E. Clark & Feldon, 2005). For example, a number of researchers used GEFT and identified their participants as two (field dependent and field independent) (DeTure, 2004; Straker-Banks, 2002) or three (field dependent, field neutral, and field independent) (Dwyer & Moore, 2002; Griffin & Franklin, 1996) groups. Based on Witkin's original research, FD/I exists with a continuous range. Participants can only show their tendencies toward either end of the continuum (Riddle, 1992). In addition, the identifying point for FD or FI groups are varied (G. Miller, 1997). A number of researchers identified participants by using participants' median (G. Miller, 1997; Palmquist & Kim, 2000; Straker-Banks, 2002), mean (Al-Saai & Dwyer, 1993), mean with standard deviation score (Dwyer & Moore, 1991, 2002) of the instrument, the median of the instrument (Emmett et al., 2003; Riddle, 1992), or even the national mean (Shih & Gamon, 2001). Because of that, it was not easy to tell whether the significant difference was due to the real difference between the groups or the way they identified the groups.

There is no long term study to trace whether learners' cognitive style will change or not. A number of researchers like Curry (1990) and Robotham (1999) argued that there is not enough empirical evidence to show whether cognitive style is temporally stable or will change over a longer period of time. Even though researchers like Claxton and Ralston (1978) reported that cognitive styles were stable in their three year longitudinal study of 40 students, researchers like Pinto, Geiger, and Boyle (1994) reported reverse findings in the same period of study for 178

students at two universities. Therefore, he suggested more longitudinal research in this field is needed.

Finally, relevant factors in learners and instructional settings are still uncertain. Researchers tried to design instruction based on learners' cognitive styles; however, it was uncertain which factors actually contributed to students' learning achievement. For example, Ausburn and Ausburn (1978) and Ragan (1979) argued that cognitive style mismatches with instruction can be only one of several reasons why learners fail in learning. Therefore, researchers who try to match instruction to cognitive style can only solve one source of failure. In addition, when the instruction fails to yield the expected outcomes, it becomes difficult to determine whether the failure is due to defective instruction or to some other factors.

A number of researchers urged that educators try to establish and realize the validity and reliability of the concepts in this discipline, choose the cognitive style model which aligned with the research objectives, and measure it with prudence. Otherwise, researchers will only realize the part but not a whole picture of the field (Cassidy, 2004; Curry, 1990; De Bello, 1990).

#### Instructional Design for a Visually-oriented Component of Online Instruction

Croft (1996) examined the literature and concluded that instruction with visually-oriented tasks should involve visual-non-verbal components. Mayer (2005b) used the term "multimedia instruction" to represent the instruction involving verbal and relevant visual-non-verbal components to foster learning. The treatment in this study was an introductory-level instruction on video-editing. The main purpose of this instruction was to provide fundamental knowledge of video-editing and fundamental operating skills of Windows Movie Maker. R. C. Clark and



Mayer (2003) suggested using the directive approach to design the fundamental operating skills section. The instruction should present content in small chunks, provide examples of demonstrations, and follow practice activities with feedback.

For designing a visually-oriented component, especially video or audio, in online learning environments, the purpose of the instruction is the most important thing which needs to be determined. This is because multimedia elements are more likely to encounter network performance issues such as bandwidth restriction problems (Catherall, 2005; R. C. Clark, 2005; Powell & NetLibrary Inc., 2002). M. G. Moore and Kearsley (2005) stated that video is a good medium for delivering instruction which presents procedures. Given that the treatment of this study was to introduce the fundamental knowledge and skills of video-editing, it had the purpose or proper reason to use visually-oriented elements because the treatment, the video-editing module, involved video-editing procedures in the instruction. Therefore, the reduction of the bandwidth restriction problems should be the main concern in terms of instructional design of the treatments. Researchers provided the following suggestions in designing visually-oriented elements (W. W. Lee, Owens, & NetLibrary Inc., 2004; Powell & NetLibrary Inc., 2002):

1. Do not display two competing animations at the same time; learners cannot focus on the main point of the instruction.
2. Avoid using continuous animated loops. Learners are easily distracted by this design. Therefore, it is better to set a couple of loops and stop.
3. Inform learners of the format and the download size of multimedia elements. In addition, instructions for downloading the required plug-ins to play the elements should be provided.

4. Provide alternative instructions for multimedia elements. Learners may not have the equipment or capability of running those elements. For instance, full motion of video can also have alternative solutions like stop motion with audio and text, or still shots with text, audio, and graphics in order to meet individuals' learning styles and needs.
5. Provide learner control functions to control multimedia elements. For example, learners should be able to play, pause, or turn the sound off of multimedia elements.
6. Use streaming technology to deliver audio or video components in online learning environments.

Accessibility is a common issue in recent years. The law of Section 508 (Center for IT Accommodation, n.d.) was enacted in 1998 to eliminate barriers in information technology. This law includes a web design standard for government units or institutions supported by the federal government to follow in order to produce electronic information accessible for people with disabilities. This standard regulates the minimum level of accessibility. Based on this standard, there are several key points for designing non-verbal elements in online learning environments:

1. All non-text elements should provide text equivalent for accessibility.
2. Information that is delivered with color should also be understandable without color.
3. All video clips with educational purposes should provide captions. In addition, those video clips should provide control functions to allow learners to play, stop, or pause based on their needs.

Other studies suggested that designers who use color to design online instruction consider how to present a correct or safe color so that the user can see the color as the designer intended. They suggested using 216 web-safe colors to create the non-verbal elements (Powell &

NetLibrary Inc., 2002; Sinclair, Sinclair, Lansing, & NetLibrary Inc., 2002). In terms of creating video clips in online settings, long video clips are not recommended because those clips require a lot of memory and are not an effective way to deliver instruction. Streaming video is suggested for online environments, and it later becomes the primary format used (Sinclair et al., 2002).

Regarding the relationship between FD/I approach and visual-non-verbal instruction, there were several studies focused on the relationship between cognitive styles and instruction with color difference or with visual-non-verbal materials (Ausburn & Ausburn, 1978; Dwyer & Moore, 1991; Livingston, 1991). For example, Livingston reported that learners' performance on a computer task would be affected by the complexity of the color presentation used. When there was more color presented in the computer task, there was lesser retention and recall capability of learners. Similarly, Dwyer and Moore (1991, 2001) suggested integrating color coding into instruction to separate details and direct students to clearly defined parts of the diagram. Because the color coded material stimulated learners' deep understanding of the instructions, its design was able to affect FD learners' learning achievement.

In CMI or distance learning environments, technology improvement provide educators and researchers more opportunities to design instruction and utilize teaching strategies for distance education which they never thought about (Riddle, 1992). In addition, providing instruction with computer technology which has support of full color, full motion, and multimedia elements that are attractive as video images which are vivid and realistic (Ikegulu & Ikegulu, 1999). This kind of instruction also evoke students with deep learning (R. C. Clark, 2005; Mayer, 2005b).

Angeli and Valanides (2004) conducted a study to investigate learners' problem-solving performance by using text-only and text-and-visual instruction with modeling software. The

results showed that instructional materials which presented in text and visual format could enhance learners' long-term memory and were better than text-only instruction. In addition, FI learners performed better in text-visual than text-only instructional material. This meant that FI learners could also benefit from external cues of the instruction. Another interesting thing was that FD learners did not benefit from those visual cues because they were lost in the complicated diagram and could not catch the key points. Therefore, by adopting appropriate instructional strategies for visual-non-verbal materials, FI and FD students could perform better than text-only learning environments.

The literature review shows that empirical studies which were designed to examine the effect of FD/I on visually-oriented tasks in online learning environments are rare today. Visually-oriented components were suggested by a number of researchers, such as Mayer (2005b) or R. C. Clark (2005) for evoking a deep understanding of the subject matter. These researchers also warned to examine the effects of visually-oriented components in students' learning achievement under different instructional objectives. Therefore, more empirical studies are needed to get a whole picture of this field.

#### Other Factors Might Impact Students' Learning Achievement

Besides cognitive styles, a number of researchers found other factors that also have a strong correlation with students' learning achievement. These factors include self-efficacy (Qutami, 2000), academic locus of control (Cassidy & Eachus, 2000), learners' satisfaction levels (Cameron, 2005), gender (Ford & Chen, 2001), attitudes and motivation (Hendrickson, 1997), or prior knowledge (Ford & Chen, 2000). Schnotz (2002) also claimed that successful

learning not only relied on cognitive processing. Other factors like emotion, motivation, and social issues should also be taken into account when making appropriate educational decisions.

On the contrary, researchers like Shih and Gamon (2001) conducted an experiment to measure learners' learning achievement between cognitive styles, motivation, and attitudes in online learning environments. They found that motivation was the only significant factor to affect learning achievement. In addition, DeTure's research (2004) indicated that students' computer-efficacy did not have a significant relationship with students' learning achievement. To realize the impact of these factors on students' learning achievement in the visually-oriented component of online instructions, this researcher adopted an instrument with high validity to identify learners' attitudes toward computer technology. In addition, a pretest and questionnaire were designed to realize the influence on students' learning achievement from their prior knowledge and online learning experiences within the module, respectively.

There are several instruments for accessing preservice teachers' attitudes toward computer technology in this field, such as the Computer Attitude Scale (CAS) developed by Gressard and Loyd (1985) and the Attitudes toward Computer Technology Survey (ACT) developed by Delcourt and Kinzie (1993). This researcher used the ACT to measure learners' attitudes to computer usefulness and computer anxiety as well as the impacts on their learning achievement.

### Summary

The literature review did not provide a definitive conclusion whether cognitive styles had strong influences on students' learning achievement in higher education or not, especially for a

visually-oriented component in Web-based learning environments. On the other hand, it provided different perspectives of the relationship among cognitive styles, distance education, visually-oriented components, instructional methods, teaching and learning strategies, and other factors that have affected students' learning achievement in previous studies, such as students' prior knowledge, attitudes, or satisfaction levels. In addition, a number of researchers examined the effect of cognitive styles, especially field dependence-independence on the factors listed above.

Web-based learning environments provide many possibilities to design instructional content and activity. Could we use cognitive styles to enhance students' learning achievement as well as to stimulate them to become self-aware and self-directed individuals? Researchers and educators all recommended more studies in this field. Especially in Web-based learning environments, more studies are needed to support or reject which factors or methods are suitable for this environment. A number of researchers and educators also urged that researchers today realize and establish the validity and reliability of the concepts in this discipline, choose the cognitive style model which aligned with the research objectives, and measure it with prudence. Only through this process will we be able to attain the whole picture of the field.

Designing instruction based on FD/I cognitive styles and applying them into a Web-based learning environment like WebCT was rare in this field when the treatment was related to visually-oriented tasks. Researchers like Angeli and Valanides (2004) suggested that the key difference between FD and FI learners is the visual perception because the FD learners have difficulty in identifying relevant information from visually-oriented instructions which provide complex learning components. Therefore, this researcher used FD/I as an indicator to identify students' cognitive styles and conducted an experiment to evaluate the effect of completing a

visually-oriented component in online learning environments. Students' learning achievement, prior knowledge, attitudes, or satisfaction levels that had been supported or rejected to have influenced by FD/I cognitive styles in traditional and hypermedia learning environments were also examined in this study.

## **CHAPTER THREE RESEARCH METHOD**

This study was designed to examine the relationship between cognitive styles, specifically field dependence-independence (FD/I), and participants' learning achievement in higher education in a visually-oriented task in an online learning environment. Other factors such as the learners' prior knowledge, attitudes toward computer technology, satisfaction levels, and learning experiences with this module were examined as well.

### Introduction

The sample for this study was 83 of 97 prospective preservice teachers enrolled in three sections of EME2040 - Introduction to Educational Technology. EME2040 is a required certificate course for all Florida State preservice teachers. This population included students from three of eleven sections (nine Web-enhanced and two World-Wide Web modes) of the course offered in the fall 2005 term. The ratio of female to male participants was 3:1. One participant was removed because this student's Pretest score was over the mean score of the Posttest in the pilot study. Thirty students were eliminated from data analysis because they belonged to field neutral (FN) cognitive styles and this type of learner does not have a strong tendency toward field dependence-independence. The remaining 52 participants were used in data analysis. The ratio of female to male participants from field dependent (FD) and field independent (FI) groups was about 2.7:1. Stratified sampling was used to randomly assign the participants into two treatment groups from three cognitive styles of FD/I. Gay and Airasian (2003) define the term stratified sampling as " ...the process of selecting a sample in such a way



that identified sub-groups in the population are represented in the sample in the same proportion that they exist in the population” (p. 106). Prior to the administration of the treatments, the participants completed Group Embedded Figures Test (GEFT) and two pretest instruments in order to measure their cognitive styles, attitudes toward computer technology, and prior knowledge. Once the cognitive style was identified by GEFT, the participants from each cognitive style (field independence, field dependence, and field neutral) were randomly assigned to the two treatment groups (Treatment A and Treatment B). Each treatment group included half of the participants from each cognitive style (see Figure 1). Following the treatments, the participants completed the Posttest and the questionnaire for data collection on their performance results and online learning experiences within the module.

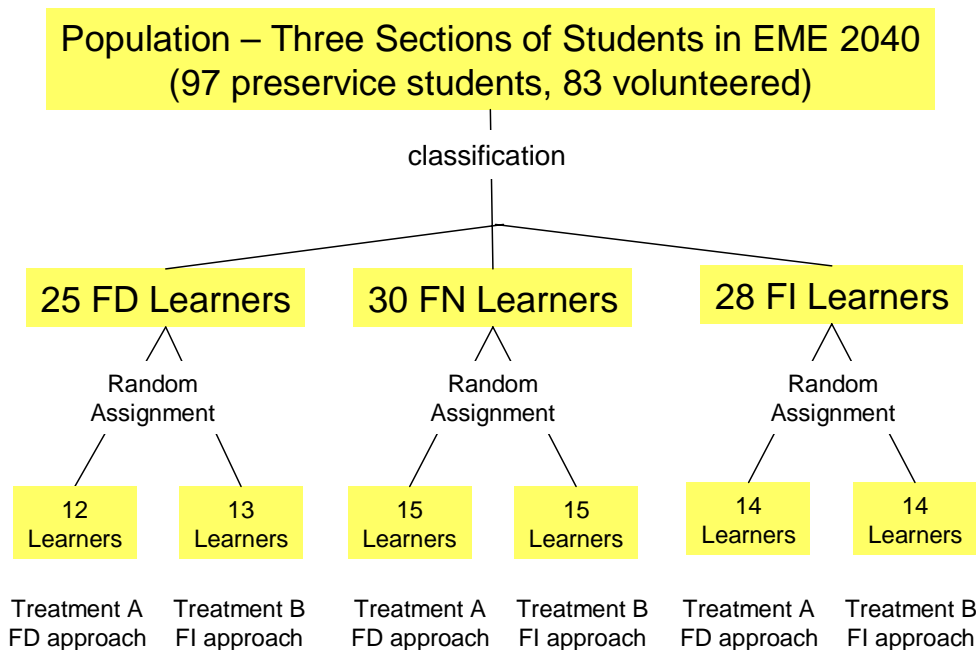


Figure 1. Stratified Sampling of the Study

The treatments consisted of two versions of an instructional module covering the topic of video-editing. The treatments were delivered through the WebCT online management

courseware. The difference between the two treatments was that Treatment A was designed for FD learners and Treatment B for FI learners. The participants normally would spend three hours a week, for two weeks (six hours total) to complete the module. The module instructions helped students to gain fundamental knowledge and performance skills of video-editing. Through the completion of the module, the participants were trained to understand the key concept of video-editing and create a movie by using the Windows Movie Maker application.

There were three statistical methods used to analyze data in this study: (1) Repeated measures with two between factors were used to analyze the differences between students' learning achievement based on their cognitive styles, treatments, or a combination of the two; (2) A two-way factorial analysis of variance (Two-Way ANOVA) was used to analyze differences in students' learning achievement and interactions based on their cognitive styles, treatments, and other factors such as students' prior knowledge, attitudes, or online experiences within the module, or a combination of these factors; (3) Multiple regression analyses were used to analyze the relationships between students' learning achievement and their cognitive styles, prior knowledge, online experiences within the module, attitudes toward computer technology, or any combination of these factors.

### Study Population and Sample Identification

The participants were preservice teachers in EME 2040 - Introduction to Educational Technology at the University of Central Florida (UCF). This researcher used three of eleven sections of the course as the population for the experiment in the fall 2005 term. Eighty-three of the 97 students in these sections volunteered to participate in this study. One of the 83 students

was removed from data analysis because this students' Pretest score exceeded the mean of the Posttest in the pilot study ( $\bar{M} = 69$ ,  $SD = 14.91$ ). Another 30 students were also removed from analysis because those students belonged to FN cognitive style, which does not have a strong tendency toward FD/I. Therefore, 52 participants remained in the data analysis sample. Only 50 of the 52 FD or FI students completed all demographic data. Of the 50 participants responding to the demographic information, the majority of participants were 18-23 years old, Caucasian, and sophomores or juniors.

EME 2040 is a required technology course for all preservice teachers seeking certification in the state of Florida and became a mandated requirement by the Florida Department of Education in 1996. All state institutions in Florida are required to offer this class. In this course, preservice teachers learn how to use and more importantly integrate technology into their other courses and their future classrooms. The curriculum of this course is beyond computer literacy. While computer and information literacy are very important for educators, today's educators also must integrate technology as a tool to facilitate learning. Educators must be able to assess technology resources and plan classroom activities using any and all available technologies. These skills are part of integration literacy, which is the ability to use computers and other technologies combined with a variety of teaching and learning strategies to enhance students' learning. Integration literacy means that teachers can determine how to match appropriate technology to learning goals, objectives, and outcomes (Shelly, Cashman, Gunter, & Gunter, 2006). Effective curriculum integration includes understanding how to integrate technology into the classroom curriculum successfully. This course curriculum is designed to teach teachers a solid foundation of computer, information literacy, and integration literacy (Gunter, 2001).

The instructional delivery mode for EME 2040 was a Web-enhanced course. Students mainly met with their instructor in a face-to-face learning environment. Instructors normally used half of the class meeting times to provide lectures, and the other half to engage students in hands-on activities (Gunter, 2001). In addition, the instructors provided online activities such as online presentations, discussions, examinations, and assignments to students.

This experiment was conducted during the later portion of the course. Therefore, the students had experience with WebCT before participating in the experiment. Based on the results of a pilot study conducted in the spring 2005 term, participants were homogeneous in prior knowledge (Pretest). This researcher designed two versions of the online module on video-editing as the treatments to conduct the experiment. Based on the study design, each participant only interacted with the instructor and peers in the same treatment group, but completed assignments or activities independently.

#### Data Collection Instrument

##### *Group Embedded Figures Test*

Group Embedded Figures Test (GEFT) was administered during a face-to-face class meeting one week prior to the beginning of the module. This instrument was used to provide validity for the paper-and-pencil version. Therefore, this instrument was conducted in a paper-and-pencil method in order to avoid bias of validity.

The instrument is divided into three separate timed sections; only the latter two sections are recorded as the grade of the instrument. The entire test duration is about 20 minutes. Based

on the preliminary norms obtained from the instrument, the mean score for college males was 12.0 (S.D. = 4.1) and for college females was 10.8 (S.D. = 4.2). Validity of this instrument was determined by its parent test, the Embedded Figures Test. The validity coefficients between these two instruments were -.82 for male undergraduates and -.63 for female undergraduates.

This researcher followed Dwyer and Moore’s research (1991, 2002) and identified learners as being one of three groups (FD, FN, and FI students). The FD learners’ scores ranged from the score which was less than one half below the standard deviation of the mean to the lowest score of the instrument; the FI learners scores ranged from the score which was more than one half above the standard deviation of the mean to the highest score of the instrument; FN learners’ scores ranged from one half below the standard deviation of the mean to one half above the standard deviation of the mean of the instrument (see Figure 2). In this study, the mean and standard deviation of 83 participants were 11.37 and 5.01; after filtering out one student whose Pretest score exceeded the mean score of the Posttest in pilot study, the mean and standard deviation were 11.33 and 5.03. Because the participants were identified as being one of three cognitive styles before taking the pretests, the FD learners’ scores ranged from 0-9, the FN learners from 10-14, and the FI learners from 15-18.

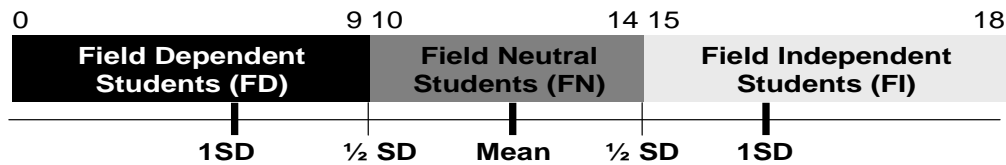


Figure 2. Score Ranges for Cognitive Styles

### *Attitude Pretest*

A modified version of the Attitudes Toward Computer Technology instrument (see Appendix A) developed by Delcourt and Kinzie (1993) was used to measure learners' perceptions in terms of computer technology. This instrument had overall internal consistency reliability coefficients of .86 and .89 reported in two research papers respectively (Delcourt & Kinzie, 1993; Zhang & Espinoza, 1997). The instrument measured learners' attitudes by using nineteen Likert-scale items in two subscales: comfort/anxiety and usefulness. In addition, this instrument had two versions; one for preservice and inservice teachers and another for the general population (Kinzie & Delcourt, 1994). This researcher used the version for preservice and inservice teachers because this version matched our population's background. By using this instrument, the participants were more likely to feel that the questions were related to their future careers. In this study, the internal consistency reliability coefficient for this instrument was .79.

### *Pretest and Posttest*

Both Pretest and the Posttest (see Appendix B for version A and Appendix C for version B) were combined with 10 multiple-choice items related to the concept of video-editing and one performance test related to the hands-on activity. The purpose of the tests was to measure the learners' knowledge and performance skills regarding the content covered in the instruction, in other words, to assess learners' knowledge-based and performance-based learning achievement. These tests were designed to be parallel tests, and were developed by this researcher and evaluated by three subject matter experts, who also taught similar subjects in traditional and Web-based learning environments. This researcher measured the difficulty level of these two

tests in the pilot study by using an independent t test. There was not a statistically significant difference in students' scores on Pretest (The mean of Treatment A was 23.57, the mean of treatment B was 30.36,  $t = -1.65$ ,  $df = 26$ ,  $p > .05$ ). These two tests were capable of being parallel tests. For Treatment A in this experiment, this researcher used version A for Pretest and version B for the Posttest. On the contrary, for Treatment B, this researcher used version B for Pretest and version A for the Posttest. Based on the Posttest scores, the results indicated that the Posttest items ranged from fair to excellent in discrimination. The coefficient for version A ranged from 0.22 to 0.63 and the coefficient for version B from 0.41 to 0.59.

### *Online Instructions*

Digital Video for Dummies (Underdahl, 2003) was used as the textbook, and the Windows Movie Maker Web site created by Microsoft (Microsoft Corporation, 2005) as the main content source in designing the online module. This module was placed in the WebCT courseware system which was password protected. Two versions of the module were designed based on two different cognitive styles: field dependence and field independence. The content for these two versions were identical. These two versions, however, adopted the instructional design methods based on the learning model designed by Chen and Macredie (2002) (see Appendix D). Based on this model, they suggested designing strategies for FD and FI learners to meet their learning preference and patterns. The specific differences of these two treatments were described as follows (see Appendix E for examples):

### *Treatment A (emphasis upon FD approach)*

#### **A. Prefer guided navigation**

Based on Chen and Macredie's model (2002), FD learners needed guided navigation for learning in non-linear learning environments to meet their learning patterns of passive approach. Treatment A used the Action Menu and the Table of Contents provided by WebCT to guide students through the materials. The Table of Contents remained on the left hand side of the screen when learners read the content materials. In addition, the page that the learners were reading would have a red dot indicator visible on the left hand side of the corresponding title on the Table of Contents.

#### **B. Guided learning**

Chen and Macredie (2002) suggested providing extra cues for FD learners to learn the content materials effectively. Treatment A used three different navigation icons, "read it", "do it", and "explore it", in the instructions to guide students through the materials. In addition, Treatment A provided extra visual cues such as diagrams or snapshots to enhance students' learning. In addition, this treatment provided a hangman game in the Key Terms part (Unit 1.1). The content of the hangman game is the same as that in Unit 1.1. The purpose of the game was to use animation (visual cues) to motivate students' learning as well as use letter clues to enable students to guess the entire word.

#### **C. Prefer map**

In WebCT, the Table of Contents was provided as a main function to guide learners through the material; this researcher did not create another map to meet this requirement. Chen and Macredie (2002), however, used maps as multiple tools to meet FD learners' tendencies to



learn concepts from the global view to a more detailed one. This researcher applied this strategy by changing the sequence of content in the Hands-on Activity part. Treatment A first provided a video tutorial to explain the operation procedures for the function covered in the unit (the global view), and then provided a step-by-step procedure in text and graphic modes (the detailed view). This difference was designed to meet the strategy that FD students needed to get the whole picture of the instructions first, and then the details.

*Treatment B (emphasis upon FI approach)*

#### **A. Prefer free navigation**

This treatment was designed for FI learners. Based on Chen and Macredie's model (2002), FI learners preferred free navigation in non-learner learning environments to meet their active approach of learning patterns. This researcher provided the Search function to help them jump to learning materials based on their preference. Even though this treatment also provided the Action Menu which includes the Table of Contents button, the Table of Contents did not remain on the left hand side of the screen as it did in Treatment A. FI learners needed to click the Table of Contents button on the Action Menu or the content module link at the top of the window in order to use this function.

#### **B. Independent learning**

Chen and Macredie (2002) suggested providing a learning environment which facilitates FI learners to construct their own knowledge. This treatment did not provide navigation icons in the instructions. In addition, this researcher took off all diagrams and snapshots in the instructions which were repeated conceptually in the verbal instructions; however, the diagrams

and snapshots which contained critical information and not information redundant to the verbal instruction parts were retained.

To correspond with the hangman game in Treatment A, an enigma game was provided in Treatment B. The content was the same in both games. The enigma game was similar to the Jeopardy game. Students could be motivated by the points which they earned from the game. The purpose of this game was to allow students to provide answers without guidance to facilitate independent learning.

### **C. Prefer index**

An index function in the Action Menu was provided in Treatment B to help FI students construct their knowledge through an individual process. The sequence of content in the hands-on activities part consisted of first the step-by-step instructions in text mode (the detailed view), and then a video tutorial explaining the function later covered in the unit (the global view). Those differences were designed to meet the strategies of the analytic method for FI learners in the learning model. These students prefer to receive fewer instructions than FD learners. In addition, they prefer to read the instructions that are presented in detail first, and then the global view later.

### *Questionnaire*

The questionnaire was developed by this researcher to measure participants' online learning experiences within the module. This questionnaire had 30 question items (see Appendix F) which covered content, navigation, modality, and satisfaction level factors. Additionally, the questionnaire contained demographic items. The types of questions included 12 multiple choice,

13 scaled to a Likert scale type and five open-ended questions to obtain both quantitative and qualitative information. The purpose of getting the qualitative data was to triangulate the data with the quantitative data from the different instruments. The two treatments used the same questionnaire except for two question items that were directly related to the functions in each treatment. The questionnaire had 13 Likert scale items, and had an internal consistency reliability coefficient of 0.87. Factor analysis showed that the Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.83, with  $p < 0.01$ . By using the Varimax with Kaiser Normalization rotation method, three components (factors) were found, and they explained 59% of the variance within the Likert scale. The variable differences between the original factor design are listed in Table 1 and the factor analysis results are displayed in Table 2.

Table 1  
Reliability and Variables in Factors in Original Factor Designs of the Questionnaire

<b>Original Factor Designs</b>			
<b>No</b>	<b>F</b>	<b>Question numbers and statements</b>	<b><math>\alpha</math></b>
1	C	2 The instructions for this video-editing module were easy to follow.	0.78
		4 The workload of this module was too heavy for me.	
		7 I would like this module to have more detailed explanations.	
		9 The content of the module is mumbo jumbo.	
		30 I think that this module was designed based on my cognitive style.	
2	N	3 I like the fact that this module allowed me to learn topics in any sequence.	0.63
		6 I was confused as to which options to select, because this module provided too many selections.	
		8 I like the fact that this module allowed me to work at my own pace and direction.	
		10 I did not know where to go when reading this module.	
3	M	5 I felt comfortable when this module changed from face-to-face to online delivery mode.	0.73
		11 I would rather to learn this module in face-to-face meetings than in the WebCT environment.	
4	S	12 I have gained a clear understanding of video-editing by learning from this module.	0.64
		18 After completing this module, I can easily use my knowledge to create a movie clip.	

Note. F = Factors, C = Content, N = Navigation, M = Modality, S = Satisfaction levels, and  $\alpha$  = Standardized item alpha. All question statements start with "Please evaluate the following statement:"

Table 2

Reliability and Variables in Factors in Factor Analysis Results of the Questionnaire

<b>Factor Analysis Results</b>				<b><math>\alpha</math></b>
<b>No</b>	<b>F</b>	<b>Question numbers and statements</b>		
1	C	4	The workload of this module was too heavy for me.	0.85
		7	I would like this module to have more detailed explanations.	
		9	The content of the module is mumbo jumbo.	
	N	6	I was confused as to which options to select, because this module provided too many selections.	
		10	I did not know where to go when reading this module.	
	M	5	I felt comfortable when this module changed from face-to-face to online delivery mode.	
		11	I would rather to learn this module in face-to-face meetings than in the WebCT environment.	
2	C	2	The instructions for this video-editing module were easy to follow.	0.73
		30	I think that this module was designed based on my cognitive style.	
	N	3	I like the fact that this module allowed me to learn topics in any sequence.	
		8	I like the fact that this module allowed me to work at my own pace and direction.	
3	M			
4	S	12	I have gained a clear understanding of video-editing by learning from this module.	0.64
		18	Please evaluate the following statement: After completing this module, I can easily use my knowledge to create a movie clip.	

Note. F = Factors, C = Content, N = Navigation, M = Modality, S = Satisfaction levels, and  $\alpha$  = Standardized item alpha. All question statements start with "Please evaluate the following statement:"

The questions (variables) related to the content, navigation, and the modality components were grouped into two factors that were not the same as this researcher originally intended. The differences might be due to the statistical fluctuation. A more extensive analysis of the reliability and validity of this instrument is needed to extend its application beyond the findings in this study.

## Data Collection Procedures

Based on the experimental design classification from Campbell and Stanley (1963), this study was a true experimental design. The data collection procedures of the study are illustrated in Figure 3. In Figure 3, R represents random assignment to divide participants into treatment groups; O represents a process of measurement or observation; X represents treatments that participants receive:

O<sub>1</sub> R O<sub>2</sub> O<sub>3</sub> X<sub>1</sub> O<sub>4</sub> O<sub>5</sub>

O<sub>1</sub> R O<sub>2</sub> O<sub>3</sub> X<sub>2</sub> O<sub>4</sub> O<sub>5</sub>

Figure 3. Study Design Form

For the experiment, GEFT (O<sub>1</sub>) was administered to participants to identify their cognitive styles and they were then placed into three groups based on their identified cognitive styles (FI, FD, and FN). Members of each group were randomly assigned (R), as well as equally divided, into two treatment groups (Treatments A and B). Therefore, each treatment group had half of the FD, FN, and FI students. They then took Attitude Pretest to measure their attitudes toward computer technology (O<sub>2</sub>) and took Pretest to measure their prior knowledge of video-editing concepts and skills (O<sub>3</sub>). After completing the three instruments, students began to learn the video-editing content and skills from the module in their groups, Treatments A or B (X<sub>1</sub> or X<sub>2</sub>). The content in both treatments was the same; however, the teaching strategy guidelines in both treatments were different. Treatment A module was designed based on the teaching strategy guidelines suggested for field independent students; Treatment B module was designed for field dependent students. The teaching strategy guidelines were based on the learning model designed by Chen and Macredie (2002) (see Appendix D). Students could decide to work at home or come

to the classroom during the class meeting time to complete the module. However, they could only interact with their classmates who were in the same treatment group. This researcher was also in the classroom to help with technical questions that were not related to the module and to direct students back to the module when they had questions related to the module. Upon completion of the modules, students took posttests to measure their learning achievement (O4) and completed the questionnaire (O5) to collect their online learning experiences within the module.

#### Data Analysis Procedures

Statistical analysis was conducted on instruments, which included GEFT, the pretests, the Posttest, and the questionnaire data. The following questions were stated for the purpose of statistical descriptions and analysis:

- A. Is there a significant difference in students' learning achievement based on their cognitive styles and treatments?

Repeated measures with two between factors were used to answer this question. These methods were used when one group was measured two times (Pretest and the Posttest), the dependent variable was interval data and two between factors (cognitive styles and treatments) were measured (Shavelson, 1996).

- B. Is there a significant difference in students' attitudes toward computer technology based on their cognitive styles and treatments?

Two-Way ANOVA was used to answer this question. This method was used to seek the difference and interaction among the means of two independent variables (factors) (Spatz & Johnston, 1984).

C. Can students' learning achievement be predicted from their cognitive styles, treatments, prior knowledge, attitudes toward computer technology, online learning experiences within the module, or any combination of these factors?

Multiple regression analyses were used to answer this question. Pedhazur and Kerlinger (1982) stated that this method was used to analyze "...collective and separate effects of two or more independent variables on a dependent variable" (p. 3). In this study, multiple regression analyses were used to predict students' learning achievement based on their cognitive styles, treatments, and other factors such as prior knowledge, attitudes, online learning experiences within the module, or any combination of these factors.

The findings of students' online learning experiences within the module were collected via questionnaire. Because the questionnaire covered four factors (content, navigation, modality, and satisfaction levels), the data collected from the questionnaire were analyzed based on these factors. Students' responses were coded from 1 to 5, corresponding to the responses of strongly disagree to strongly agree. The scores for negative items in each area were reverse-coded. Therefore, students with higher scores had more positive attitudes toward online learning experiences within the module.

D. Is there a significant difference in students' satisfaction levels based on their cognitive styles, treatments, prior knowledge, or any combination of these factors?



Two-Way ANOVA was used to analyze this question because this method was used to seek the difference and interaction between two or more independent variables (factors).

This researcher also collected qualitative data from open-ended questions in the questionnaire. The main purpose of the collection of qualitative data was to triangulate the data from the instruments. This researcher identified participants as being one of three groups (FI, FD, and FN); however, the FN group was not analyzed in this study because this type of learner did not have a strong tendency toward field dependence or field independence. Therefore, only data from 52 students were analyzed to answer research questions. The Statistical Package for Social Science, Personal Computer Version (version 11) was the computer application used to analyze the data results.

### Pilot Study

A pilot study was conducted in the spring of 2005. The participants were 35 students enrolled in one section of EME 2040 and the sample was 28 students who completed all instruments correctly. The purpose of the pilot study was to verify the process of the experiment and the filter point of the Posttest. In addition, the pilot study was used to determine whether the Pretest and the Posttest were parallel in content and difficulty level. This pilot study also tested the validity as well as the reliability of all instruments created by this researcher.

Based on the results of the pilot study, cognitive style, the treatments, and most other factors did not serve as a main factor for successful completion of a visually-oriented component of online instructions. Several issues were identified in the pilot study. The issues and solutions were as follows:

**Issue:** The participants were enrolled in a Web-enhanced course. Even though the instructor and this researcher encouraged them to work individually or interact with other peers online, 60% of participants completed their module in their classroom instead of their homes. In addition, this module was conducted at the end of the semester and students had already established their groups; it was not easy to ask them to study individually. Therefore, if participants with different treatments studied together, this could have affected the results.

**Solution:** This researcher came to students' classroom to emphasize the importance of the study individually before the experiment began. Additionally, this researcher came to the classroom to observe the situation and helped them to work with other peers online instead of those in the classroom.

**Issue:** This study had some unexpected variables. For example, this researcher wrote the instructions and set the pop-up windows to remind students to take the pretests before reading the content module. Some students still missed the instructions and read the content module first.

**Solution:** This researcher adjusted the functions in WebCT such that the online modules could not be read until the participants completed the pretests. In addition, this researcher designed a "Read Me First" module to guide the participants to complete the experiment.

**Issue:** A number of students reported that they felt frustrated because they saw their original instructor in the classroom but the instructor was told not to answer questions related to the module. Even though this researcher was waiting for questions online, the participants ignored the online help because they were used to receiving an immediate response from the instructor in the class. A number of participants were confused with who was the facilitator in the module; they still asked their original instructor questions. This researcher only received some technical questions from students during the study.

**Solution:** This researcher emphasized that this researcher was the instructor of the module and also showed up in the classroom to direct those face-to-face interactions into online interactions. The original instructor was in her office instead of the classroom for providing help if needed.

**Issue:** Directions or instructions were unclear. Some students thought the assignment was group work and submitted the same movie clip for their grading. This researcher did not expect students to submit the assignment as a group. Because the instructions did not mention that it was supposed to be individual work, this researcher still graded the scores as their individual work.

**Solution:** This researcher modified and updated all instruments and online modules to correct misleading or unclear instructions based on the observation during the experiment and feedback from the questionnaire.

## CHAPTER FOUR ANALYSIS OF THE DATA

### Introduction

This study was designed to examine the effect of cognitive styles, specifically field dependence-independence (FD/I), on student learning achievement in a visually-oriented task of online instructions in higher education. Other factors such as participants' prior knowledge, online learning experiences within the module, attitudes toward computer technology, and satisfaction levels were examined. Data analysis was used to determine the differences in learning achievement or satisfaction levels between participants who received the instructions based on their cognitive styles and those who did not receive the instructions based on their cognitive styles. In addition, this researcher examined whether the participants' learning achievement or satisfaction levels were predicted by their cognitive styles, treatments, prior knowledge, attitudes toward computer technology, online experiences within the module, or any combination of these factors.

The population of this study was preservice students in three sections of the EME 2040 course – Introduction to Educational Technology at the University of Central Florida (UCF). These three sections of the course were taught by one instructor. Ninety-seven preservice teachers were in these three sections of the course, and 83 of them volunteered to participate in this study. One of the participants was removed because this student's Pretest score was higher than the mean point of the Posttest in the pilot study ( $\bar{M} = 69$ ). Thirty students were eliminated from data analysis because they belonged to field neutral (FN) cognitive styles and this type of

learner does not have a strong tendency toward FD/I. The remaining 52 field dependent (FD) or field independent (FI) students became the sample for this study and were used in data analysis.

Of the 50 participants responding to the demographic information (see Table G1 and G2), more than 82% of the participants were 18-23 years old, Caucasian, and sophomores or juniors. The ratio of male to female participants was 1: 2.7. Most participants had taken one to two computer application courses and one to four online courses in WebCT before. Of those participants who had taken courses in WebCT before, a Web-enhanced course was the type of online course they had taken most. For this study, more than 91% of the students completed the module in six hours and more than 50% of the participants completed this module at home instead of at other places. Two-Way ANOVA was used to determine participants' demographic data differences based on their cognitive styles and the treatments. Only participants' gender had a statistically significant difference between cognitive styles ( $F_{1,48} = 5.81, p < .05$ ); Male participants were more likely to be field independent (FI) learners.

This researcher followed Dwyer and Moore's research (1991, 2002) and divided the participants into three groups (FD, FN, and FI students) based on their identification of cognitive styles. The participants were identified as one of three cognitive styles using the initial 83 students. The mean score of the instrument was 11.37 and the standard deviation was 5.01. FD participant scores ranged from 1 to 9, FN scores ranged from 10-14, and FI scores ranged from 15-18.

Repeated measures with two between factors, Two-Way ANOVA, and multiple regression methods were used to analyze the data in this study. The data collected from FD and FI participants were used to analyze research questions. The data collected from FN participants were not analyzed because FN participants do not have a strong tendency toward FD/I. A .05

significance level was used as the basis for determining statistical significance in this study.

Tables labeled with a G prefix are provided in Appendix G. The findings of this study are listed by research hypotheses as follows:

### Hypothesis A

*In online learning environments, there will be a statistically significant difference in the learning achievement between students who received instructions based on their cognitive styles and those who received instructions not based on their cognitive styles (field dependence and field independence).*

Repeated measures with two between factors were used to analyze this hypothesis. Pretest and the Posttest for the treatment contained ten multiple-choice items for measuring students' knowledge-based skills and one performance test for measuring their performance-based skills of the content covered in the module; findings for knowledge-based and performance-based learning achievement are presented separately.

#### *Knowledge-based Learning Achievement*

There was a statistically significant difference ( $F_{1, 45} = 43, p < .01$ ) between participants' Pretest ( $\bar{M} = 25.61, SD = 8.88$ ) and the Posttest ( $\bar{M} = 37.04, SD = 10.15$ ) scores in students' knowledge-based learning achievement in online learning environments (see Tables 3 and G3). Approximately 49% of the variance could be explained by the time tests. There was also a statistically significant difference in students' learning achievement and the treatments ( $F_{1, 45} = 9.15, p < .01$ ). The participants in Treatment A (which emphasized the FD approach) ( $\bar{M} = 38.2,$

SD = 9.12) had higher scores than those in Treatment B (which emphasized on the FI approach) ( $\bar{M} = 35.83$ , SD = 11.2). About 17% of the variance could be explained by the treatments.

There was not a statistically significant difference in students' knowledge-based learning achievement based on students' cognitive styles ( $F_{1,45} = 1.04$ ,  $p > .05$ ) or the interaction between the treatments and students' cognitive styles ( $F_{1,45} = 0.13$ ,  $p > .05$ ).

Table 3  
Participants' Learning Achievement Based on Their Treatments, Cognitive Styles and Interaction

Variables	Knowledge-based		Performance-based	
	df	F	df	F
<b>LA (Pretest to the Posttest)</b>	1,45	43**	1,48	1644.25**
<b>LA and the treatments</b>	1,45	9.15**	1,48	1.42
<b>LA and cognitive styles</b>	1,45	1.04	1,48	0.18
<b>LA, cognitive styles, and the treatments</b>	1,45	0.13	1,48	0.11

Note. LA stands for learning achievement. \*means significance at  $< .05$  and \*\* means significance at  $< 0.01$ .

### *Performance-based Learning Achievement*

There was a statistically significant difference ( $F_{1,48} = 1644.25$ ,  $p < .01$ ) between Pretest ( $\bar{M} = 0$ , SD = 0) and the Posttest scores ( $\bar{M} = 45.34$ , SD = 7.94) in students' performance-based learning achievement (see Tables 3 and G4). Approximately 97% of the variance could be explained by the time tests; however, there was not a statistically significant difference in students' learning achievement based on the treatments ( $F_{1,48} = 1.42$ ,  $p > .05$ ), students' cognitive styles ( $F_{1,48} = 0.18$ ,  $p > .05$ ), or the interaction between the treatments and students' cognitive styles ( $F_{1,48} = 0.11$ ,  $p > .05$ ).

The findings indicated that participants improved their scores from Pretest to the Posttest. The students also had better knowledge-based learning achievement in Treatment A. However,

cognitive styles and the interaction between cognitive styles and the treatments did not influence students' knowledge-based learning achievement. Furthermore, the treatments, cognitive styles, and the interaction between the treatments and the cognitive styles did not influence students' performance-based learning achievement.

### Hypothesis B

*There will be a statistically significant relationship between students' learning achievement and students' cognitive styles, treatments, prior knowledge, attitudes toward computer technology, online experiences, satisfaction levels, or any combination of these factors.*

Multiple regression analyses were used to analyze this hypothesis. This researcher used both knowledge-based and performance-based posttest scores as dependent variables to analyze the hypothesis because students' learning achievement could be analyzed in two components.

#### *Knowledge-based Learning Achievement*

The content factor of online experiences within the module was the only factor that had a statistically significant relationship with students' knowledge-based learning achievement ( $F_{1,46} = 8.46, p < 0.05$ ). Students who had higher positive opinions about the content factor of online learning experiences within the module (see Tables G16 to G20 for descriptive data) demonstrated higher knowledge-based learning achievement scores. About 16% of the variance could be explained by the factor. The equation was as follows:

$$Y' (\text{Knowledge-based learning achievement}) = 22.29 + 0.88 * (\text{content})$$



### *Performance-based Learning Achievement*

Participants' prior knowledge was the only factor that had a statistically significant relationship with participants' performance-based learning achievement ( $F_{1, 50} = 4.86, p < 0.05$ ). Students who had higher scores on their Pretest earned higher performance-based learning achievement scores. Only about 9% of the variance, however, could be explained by the students' prior knowledge factor. The equation was as follows:

$$Y' \text{ (Performance-based learning achievement)} = 38.38 + 0.27 * \text{(Pretest)}$$

Based on the findings, students who had positive attitudes toward the content of the module exhibited higher knowledge-based learning achievement; students who had higher scores on their prior knowledge (Pretest) demonstrated higher performance-based learning achievement.

### Hypothesis C

*There will be a statistically significant difference in students' attitudes toward computer technology among students who have different cognitive styles (field dependence and field independence) and are in different treatment groups.*

Two-Way ANOVA was used to answer this hypothesis. Students' attitude scores were collected from two subscales: comfort/anxiety and computer usefulness. A higher score on the comfort/anxiety scale meant that the participant had a higher comfort attitude; a higher score on the computer usefulness scale meant that the participant felt that the computer was more useful.

The findings indicated a statistically significant difference in students' comfort attitudes toward computer technology based on their cognitive styles ( $F_{1, 48} = 7.12, p < .05$ ). About 13% of the variance could be explained by their cognitive styles. FI students had higher comfort attitudes

than FD students (see Table G5). On the other hand, there was not a statistically significant difference in students' comfort/anxiety levels based on their treatments ( $F_{1,48} = .9, p > .05$ ) and the interaction between students' cognitive styles and the treatments ( $F_{1,48} = 1.56, p > .05$ ).

Regarding students' computer usefulness attitudes toward computer technology, there was not a statistically significant difference based on their cognitive styles ( $F_{1,48} = 0.48, p > .05$ ), the treatments ( $F_{1,48} = 0.1, p > .05$ ), and the interaction between their cognitive styles and the treatments ( $F_{1,48} = 0.51, p > .05$ ). Please see Table G6 for descriptive information.

Based on the findings, FI students felt more comfortable about computer technology than FD students. Students, however, did not have a statistically significant difference in computer usefulness attitudes toward computer technology based on their cognitive styles, treatments, and the interaction between their cognitive styles and the treatments.

#### Hypothesis D

*In online learning environments, there will be a statistically significant difference in students' satisfaction levels between students who received instructions based on their cognitive styles and those who received instructions not based on their cognitive styles (field dependence and field independence).*

Two questions in the questionnaire were related to students' satisfaction levels. Descriptive data were used to display students' responses (see Tables G7 and G8). In addition, scores were converted (Strongly Disagree to Strongly Agree is equal to 1 to 5) and summed to run the Two-Way ANOVA to check students' attitude tendencies based on their cognitive styles and the treatments (see Table G2).

There was not a statistically significant difference in students' satisfaction levels based on their cognitive styles ( $F_{1, 46} = 0.01, p > .05$ ), treatments ( $F_{1, 46} = 0, p > .05$ ), and the interaction between their cognitive styles and the treatments ( $F_{1, 46} = 0.06, p > .05$ ). On the other hand, the data from Table G8 indicated that about 82% to 86% of students in Treatment A responded that they somewhat agreed or strongly agreed that they could easily create a movie after completing this module. On the contrary, only 67% to 69% of students in Treatment B responded with the same feeling.

### Supplemental Findings

In order to present a more representative picture of the study, there were several quantitative findings that were not directly related to the research questions and some qualitative findings that were collected from field notes during the experiments, interviews with the instructor of the course, and open-ended questions in a questionnaire that were used to triangulate the accuracy of the study. In the questionnaire, students' responses were coded from 1 to 5, corresponding to the answers from strongly disagree to strongly agree. The scores for negative items in each area were reverse-coded. Therefore, students with higher scores had more positive attitudes toward online learning experiences within the module. These findings were coded and presented in different themes as follows:

#### *Content Issues*

Five questions were designed to assess students' opinions about the content factor of online learning experiences within the module (see Tables G16 to G20). Two-Way ANOVA was

used to examine whether there were significant differences in students' attitudes toward the content factor of online learning experiences within the module between students' cognitive styles, treatments, and the interaction between their cognitive styles and the treatments.

There were three questions for which students had significant differences in their content factor of online learning experiences within the module based on their cognitive styles or the treatment. First, as shown in Table G16, students who were in Treatment B (FI approach) felt the instructions of the module were easier to follow than those who were in Treatment A (FD approach) ( $F_{1,46} = 5.68, p < .05$ ). In Treatment B (FI approach), about 75% to 85% of the students from both cognitive styles somewhat agreed or strongly agreed that the instructions of the module were easy to follow. In Treatment A (FD approach), only 45% to 50% of the students from both cognitive styles expressed the same feelings. Second, as listed in Table G17, FD students felt the workload of this module was heavier than FI students ( $F_{1,46} = 5.63, p < .05$ ), regardless of the treatment. About 15% to 27% of the FD students somewhat agreed or strongly agreed that the workload of the module was too heavy for them, although only 7% to 8% of the FI students felt the same way. Third, as presented in Table G18, FD students would have liked this module to have more detailed explanations than FI students ( $F_{1,46} = 4.24, p < .05$ ), regardless of the treatment. More than 50% of FD students somewhat agreed or strongly agreed that this module needed more detailed explanations. Only 25% to 36% of FI students felt the same way.

Of the five questions about the content factor of online learning experiences within the module, there were two questions for which students did not have significant differences based on their cognitive styles, treatments, and the interaction between their cognitive styles and the treatments. Across the FD and FI groups, the results revealed that more than 50% of the students

felt the module was understandable (see Table G19) and about 43% of the students were not certain if the module was designed based on their cognitive styles (see Table G20).

### *Modality Issues*

The Attitudes Toward Computer Technology instrument does not ask questions specifically related to online learning; this researcher created two questions in the questionnaire related to participants' attitudes toward learning modality (see Tables G10 and G11). The results of a bivariate correlation analysis revealed that students' comfort/anxiety level had a positive correlation with the learning modality factor ( $n = 50$ ,  $r = .47$ ,  $p < .01$ ).

Based on the data collected from the modality factor, students' opinions about the modality factor of the online learning experiences within the module were not significantly different depending on their cognitive styles, treatments, and the interaction between their cognitive styles and treatments.

As shown in Table G10, students had varied responses to their comfort levels when this module changed from face-to-face to online delivery mode, given the distribution of scores on this question. Even though students' comfort levels were quite varied, the results in Table G11 indicated that about 60% of the students in the FD and FI groups felt that they would have liked to learn the module in face-to-face meetings rather than in the WebCT environment.

As shown in the field notes from this researcher, a number of students asked "Where should I begin?" or "How do I begin this module?" in the classroom during the experiment, regardless of their cognitive styles and treatment condition. Several students thought they would

have a lecture before the experiment; however, these comments were only made when they began the module.

### *Navigation Issues*

There were four questions in the questionnaire related to the navigation factor in students' online learning experiences within the module. By using Two-Way ANOVA, students were not statistically significantly different in their opinions about the navigation factor of the online learning experiences within the module depending on their cognitive styles, treatments, and the interaction between their cognitive styles and the treatments (see Tables G12 to G15).

As shown in Table G12, 90% of students in the FD and FI groups somewhat agreed or strongly agreed with the fact that this module allowed them to learn topics at their own pace and direction. In addition, the data in Table G14 revealed that 70% of students in the FD and FI groups liked the fact that the module provided enough freedom for them to learn topics in any sequence. Furthermore, as shown in Table G13, only 30% of the students in the FD and FI groups were confused by the module because it provided too many selections. The findings from Table G15 also revealed a similar result; only 20% of the students in the FD and FI groups did not know where to go when reading the module, regardless of the cognitive styles and the treatment.

### *Interaction Issues*

During the experiment, this researcher encouraged participants to interact with their classmates or this researcher in the WebCT environment. There were student-to-student and

teacher-to-student interactions in the classrooms; however, only students in Treatment A (FD approach) asked this researcher questions in WebCT via discussion postings, although the questions were few. In addition to replying to specific questions that students had asked, this researcher also made several announcements to both treatment groups and made sure the announcements in each treatment were identical. The data about how many discussion postings had been read by the participants during the experiment were collected and Two-Way ANOVA was used to analyze the difference based on students' cognitive styles and the treatments. The results revealed a statistically significant difference based on students' treatments ( $F_{1,48} = 4.86, p < .05$ ). Students in Treatment A (FD approach) read more discussion postings than those in Treatment B (FI approach) (see Table G21).

### *Technical Issues*

The participants were provided with two weeks to complete the experiment; participants could choose to work at home or come to the classroom if they needed help with technical issues or did not have a proper computer at home. The classroom had computers and was available during the regular class meeting time. Therefore, most students reported that they did not encounter any technical issues. A number of students, however, reported that their computers kept freezing during the experiment because Windows Movie Maker is a program that needs a high amount of memory to process video-editing tasks. For example, one student reported that "...my computer froze a lot so I had a hard time finishing, but I did." This researcher and the instructor of EME 2040 also observed similar situations in the classroom.

### *Opinions about the Module*

When this researcher asked what the participants liked most about this module, several students reported that they liked learning how to create videos at their own pace and the fact that the instructions were not overwhelming. For example, one student reported that "...[This module] allowed me to explore the program, at my own pace and [use] my own creative style, though still giving me enough direction that I did not feel overwhelmed." A number of students reported that video tutorials and snapshots were useful to understand the instructions. One student even described that "...I also liked that the videos [tutorials] helped explain how to use the software. I don't think I would have been able to [do] the assignment [performance-based posttest] if there had only been written directions..." A number of FI students mentioned that they most liked that the assignment allowed them to make the video with their own styles. On the other hand, FD students did not make this kind of comment.

When this researcher asked what the participants liked least about this module, a number of students reported that several directions were wordy or confusing. One FI student in Treatment A reported that "I found it difficult to learn how to use a new kind of software. I got confused in the directions, but I think that was because I wasn't reading through everything first. I kept trying to work ahead without reading and would get confused." In addition, several students felt frustrated with learning a new concept through reading. FD students seem to be more confused with the directions or the instructions than FI students regardless of the treatments; FI students felt the instructions were too long or boring compared to FD students, regardless of the treatments. Even though this researcher provided a discussion board and encouraged students to interact online, discussion postings in WebCT were limited between the instructor or this



researcher and students. One student reported that “[It was] hard to ask for help on the little things.” Based on the field notes, students within the same treatment group had interactions in the classroom during the experiment. Instructors and this researcher also encouraged students who were frustrated with the instructions to take a break and study when they felt comfortable. A number of students reported that they felt isolated during the experiment. Several students wanted to learn this module in the face-to-face environment.

### Summary

This study was designed to examine the effect of cognitive styles in field dependence-independence upon completing a visually-oriented task in an online learning environment in higher education. Eighty-three preservice teachers participated in this study, fifty-two of whom had cognitive styles identified as field dependence or field independence. Data from these 52 participants were analyzed to answer the research questions. Two-Way ANOVA, repeated measures with two between factors, and multiple regression analyses were used to analyze the research questions. A 0.05 significance level was used as the basis for determining statistical significance. The findings are presented as follows:

1. Students improved their scores from Pretest to the Posttest. The students’ knowledge-based learning achievement in Treatment A (FD approach) was significantly higher than that in Treatment B (FI approach).
2. There was no statistically significant difference in students’ knowledge-based learning achievement based on their cognitive styles and interaction between their cognitive styles and the treatments.

3. There was not a statistically significant difference in students' performance-based learning achievement based on their cognitive styles, treatments, and the interaction between their cognitive styles and the treatments.
4. By examining students' cognitive styles, treatments, prior knowledge, attitudes toward computer technology, online learning experiences within the module, and interactions between these factors as predictors, students who had higher positive attitudes toward the content factor of online learning experiences within the module demonstrated higher knowledge-based learning achievement scores.
5. By examining students' cognitive styles, treatments, prior knowledge, attitudes toward computer technology, online learning experiences within the module, and interactions between these factors as predictors, students who had higher prior knowledge scores (Pretest) demonstrated higher performance-based learning achievement scores.
6. FI students had higher comfort levels toward computer technology than FD students.
7. There was no statistically significant difference in students' comfort/anxiety attitudes toward computer technology based on their treatments and the interaction between students' cognitive styles and the treatments.
8. There was no statistically significant difference in students' computer usefulness attitudes toward computer technology based on their cognitive styles, treatments, and the interaction between students' cognitive styles and the treatments.
9. There was not a statistically significant difference in students' satisfaction levels based on their cognitive styles and the treatments. By examining the descriptive data,

however, it seems that students in Treatment A (FD approach) had higher satisfaction levels than those in Treatment B (FI approach).

In this study, a number of supplemental findings were collected from the quantitative and the qualitative data to triangulate the research hypotheses. Those findings are as follows:

1. Male participants were more likely to be identified as FI learners.
2. Based on students' opinions about the content factor of the online learning experiences within the module, students who were in Treatment B (FI approach) felt the instructions were easier to follow than those who were in Treatment A (FD approach), regardless of their cognitive styles. Even though students felt the module was understandable regardless of their cognitive styles and the treatment, FD students felt the workload of the module was heavier and needed more detailed explanations than FI students; FI students felt the instructions were more wordy or boring than FD students, regardless of the treatment.
3. The majority of students would have liked to learn this module in face-to-face meetings rather than in the WebCT environment, regardless of the cognitive styles and the treatment. The field notes also revealed the findings that numerous students needed a transition at the beginning of the experiment when the module moved from face-to-face to online delivery mode, regardless of the cognitive styles and the treatment.
4. Based on students' opinions about the navigation factor of the online learning experiences within the module, most students appreciated the fact that the module allowed them to learn topics at their own pace and direction. Furthermore, more than

70% of the students did not get lost in the module or feel confused by multiple navigation options provided in the module.

5. Students in Treatment A (FD approach) read more discussion postings than those in Treatment B (FI approach).
6. Students did not encounter any critical technical issues during the study.
7. There was student-to-student interaction in the classroom and not in the WebCT environment.
8. There was teacher-to-student interaction in both the classroom and Treatment A (FD approach) of the WebCT environment. The interactions focused on technical issues and emotional issues.

## **CHAPTER FIVE DISCUSSIONS, CONCLUSIONS, AND RECOMMENDATIONS**

This study was designed to examine the effect of cognitive styles, specifically field dependence-independence, on completing visually-oriented tasks in an online learning environment in higher education. Other factors such as the participants' prior knowledge, attitudes toward computer technology, and online learning experiences within the module were examined. Eighty-three preservice teachers at the University of Central Florida (UCF) participated in this study. Data from 52 participants were analyzed to answer the research questions. The discussions follow the research hypotheses.

### Hypothesis A

*In online learning environments, there will be a statistically significant difference in the learning achievement between students who received instructions based on their cognitive styles and those who received instructions not based on their cognitive styles (field dependence and field independence).*

The results revealed that the participants improved their scores from Pretest to the Posttest and those who were in Treatment A (FD approach) demonstrated higher knowledge-based learning achievement than those who were in Treatment B (FI approach), regardless of their cognitive styles. The possible reasons are as follows:

As shown in Tables G3 and G4, even though FI students had higher scores than FD students regardless of their treatments and test types, treatment was the only factor that had a statistically significant difference. In other words, this finding revealed that both FD and FI

students performed equally well in online learning environments if they received the instructions designed in Treatment A (FD approach). This result also echoed the findings of Downing (2005) as well as Shih and Gamon's research (2001) that students from both cognitive styles could learn equally well in web-based learning environments.

In order to understand which difference in the two treatments caused students to demonstrate higher knowledge-based learning achievement in Treatment A, this researcher used findings from a questionnaire or qualitative data to examine the results. The differences between the two treatments are: Treatment A focused on FD approach and Treatment B focused on FI approach. Treatment A provided guided navigation, extra cues, and the global view followed by the detailed view in the instructions. Treatment B provided free navigation, less cues for independent learning, and the detailed view followed by the global view in the instructions.

By reviewing students' navigation issues, students did not have significant differences based on their cognitive styles and the treatments. The reason might be that the content structure was straightforward and provided an introductory-level instruction on video-editing. Students did not need to use varied navigation tools to construct their higher-order thinking. As such, there was no significant difference in students' opinions about the navigation.

By reviewing students' content issues, students from both cognitive styles felt that the instructions in Treatment B were easier to follow than those in Treatment A. The possible reasons are as follows: First, Treatment B did not display the Table of Contents on the left side of the screen when students were reading the module. Therefore, instructions in Treatment B had a larger space to present content. Second, based on the observation in classrooms, most students were reading the instructions on the screen directly. Additionally, they needed to read the instructions in the WebCT courseware and work on their hands-on activities in Windows Movie

Maker at the same time. In other words, they needed to open two applications and flip back and forth for reading and practicing during the experiment. Therefore, if a larger portion of the content could be presented on the screen, then the time students need to flip back and forth between applications would be reduced. Third, based on the field notes and open-ended questions, a number of students reported that they preferred to see the video tutorials before the step-by-step instructions which were written in text and graphic mode. Therefore, the display setting of the Table of Contents might be the main reason that students felt the instructions in Treatment B (FI approach) were easy to follow.

Researchers, such as Oblinger and Hawkins (2005) and Angeli and Valanides (2004), indicated that undergraduate students today prefer graphics over text. Mayer (2005a) stated that students can learn deeply when relevant graphics are added to text. In addition, Angeli and Valanides also proved that FI students could benefit from text-and-visual instructions. Therefore, FI students obtained better scores in Treatment A which provided extra cues. Furthermore, Palmquist and Kim's research (2000) reported that FD students could overcome their disorientation and use the same amount of time as FI students to complete the tasks if they received the instructions based on their cognitive styles. The findings in Table G2 also revealed the same results.

Researchers such as Dwyer and Moore (1991, 2001) also showed that extra cues could improve students' learning achievement. On the other hand, more guidance and extra cues did make several FI students feel that the instructions were too wordy or even boring as other empirical studies' findings showed (Ausburn & Ausburn, 1978; Chen & Macredie, 2004; J. W. Keefe, 1982; Wilson, 1998); however, students earned better scores in Treatment A than in Treatment B. Therefore, Robotham's suggestions (1999) about providing instructions with

respective cognitive styles in the introductory-level courses to help learners establish essential knowledge and build their confidence might be suitable for FD learners. In addition, Robotham's suggestions for providing students with different kinds of learning strategies in the advanced courses to simulate students' potential might be also applicable to the FI students in the introductory-level courses.

This module provided introductory-level instruction in video-editing. The findings implied that providing more guidance and extra cues is more important than providing varied functions to construct students' higher-order thinking. A simple navigation function such as a Table of Contents might accommodate both FD and FI students. FD students could follow the sequence presented in the Table of Contents and FI students could also construct their own knowledge by using this function to jump from one topic to another topic without following the sequence designed by this researcher. Therefore, it is possible that students benefited more from Treatment A than from Treatment B, due to the extra guidance and cues.

The findings in this study also indicated that students from both cognitive groups had higher satisfaction levels in Treatment A (FD approach). Extra cues and sequence of content might be the reasons that students obtained better scores in Treatment A (FD approach) than in Treatment B (FI approach). The results from open-ended questions also confirmed these findings.

The results showed that students' performance-based learning achievement scores were not statistically significantly different based on their cognitive styles and treatments. One possible reason was that this module allowed students to resubmit their assignments that were counted as their scores for performance-based learning achievement before the deadline. Therefore, the opportunity to revise and submit the assignment multiple times might override any difference based on their cognitive styles and treatments.



## Hypothesis B

*There will be a statistically significant relationship between students' learning achievement and students' cognitive styles, treatments, prior knowledge, attitudes toward computer technology, online experiences, satisfaction levels, or any combination of these factors.*

Students' feedback about the content factor of online learning experiences within the module was the only factor that had a statistically significant relationship with students' knowledge-based learning achievement regardless of their cognitive styles and the treatments. Additionally, students who had more prior knowledge (higher Pretest scores) demonstrated higher performance-based learning achievement. The possible reasons are:

Students' opinions on the content factor of online learning experiences within the module were related to how they felt about the content presentation within the module. The findings of this hypothesis indicated that students would obtain a higher knowledge-based learning achievement score if students felt the instructions were easy to follow and the workload of the module was manageable. Researchers, such as Chen and Macredie (2004), demonstrated that students' attitudes toward the content presentation of the treatment had significant differences based on their cognitive styles. Even though the findings in Chen and Macredie's study did not measure the relationship between students' attitudes toward the content presentation of the treatment (the content factor of online learning experience within the module) and students' learning achievement, the findings in this study demonstrated that students who had higher scores on the content factor of online learning experience within the module earned better scores in their knowledge-based learning achievement regardless of their cognitive styles and the treatment.

Based on the findings from open-ended questions and field notes, several students read the assignment first, and then read the related instructions to perform the assignments. Therefore, some of the students missed the key concepts and did not create the video (their assignment) with the correct format. Furthermore, FD students felt that they needed more detailed explanations and clear directions. Researchers such as James and Gardner (1995) as well as Chen and Macredie (2004) suggested creating a flowchart or map to help students overcome the disorientation. A map or flowchart that presents the relationship between the tasks of the assignment and the instructions might help students learn the instructions effectively and overcome their disorientation.

Students' prior knowledge was correlated with performance-based learning achievement, which has also been supported (Ford & Chen, 2000) or suggested (R. E. Clark & Feldon, 2005) by previous studies. The module was designed to provide an introductory-level instruction on video-editing; this module also belonged to an advanced-level computer application instruction in EME 2040 – Introduction to Educational Technology. Therefore, students with higher scores of prior knowledge should be able to demonstrate higher performance-based learning achievement scores, regardless of the cognitive styles and the treatments.

This study involved a small sample size, which might explain why the other factors that were examined in this study did not have a statistically significant result. Moreover, students had two weeks to complete this module. Other factors, such as students' attitudes toward computer technology, might be affected by student-to-student or teacher-to-student interactions, which might explain the lack of statistically significant results for these factors.

## Hypothesis C

*There will be a statistically significant difference in students' attitudes toward computer technology among students who have different cognitive styles (field dependence and field independence) and are in different treatment groups.*

FI students felt more comfortable toward computer technology and provided more positive feedback on the modality factor of online learning experience with the module. FD and FI students, however, did not have a statistically significant difference in their learning achievement scores. The possible reasons are as follows:

This experiment was conducted in the later portion of the semester and students had built their interaction patterns outside of online discussion postings. Additionally, students had two weeks to complete their module. Students who felt less comfortable toward computer technology might have sought help from other classmates and performed equally well as students who felt much more comfortable toward computer technology. Researchers, such as Chen and Paul (2003), also indicated that disorientation and extra support were the critical issues in Web-based instructions; researchers such as M. G. Moore (2001) and Sorg et al. (1999) highlighted the importance of teacher-to-student and student-to student interactions to the Web-based instructions. Based on the findings from field notes, the teacher-to-student and the student-to-student interactions to alleviate students' frustration during the experiment might have affected the results.

Students could decide to work at home or work in classrooms if they did not have a proper computer at home or if they needed technical help that was not related to the module. This situation might comfort students who were not comfortable with computer technology. As such,

this situation might also explain why students with more positive attitudes toward computer technology did not demonstrate higher learning achievement scores.

The findings in Table G11 indicated that the majority of students would have liked to learn this module in face-to-face meetings than in the WebCT environment. The findings from field notes and open-ended questions also reflected participants' frustration. The possible reasons are below.

By examining students' demographic data, this researcher found that over 80% of students were 18 to 23 years old. This generation normally spends more time on games and TV, but less time on reading. They are technologically savvy but use technology more on social relationships than academic context (Dziuban, Moskal, & Hartman, 2005). Because students were required to read the instructions and complete activities and tasks in an online learning environment, the experiment design might have affected their attitudes.

This experiment was conducted in the later portion of the semester and the participants mainly received instructions in the face-to-face environment in this course. Therefore, they felt frustrated when they had to learn this module in the WebCT environment. In addition, EME 2040 also had two World Wide Web mode sections available for students to take. Because our participants came from the Web-enhanced mode sections, it might indicate that the participants have liked to learn the module mainly from face-to-face meetings. Therefore, the participants might have been more frustrated because they did not expect to learn this module in the WebCT environment and the modality change might have affected their feelings.

This experiment was designed for students to only interact with this researcher or their classmates within the same treatment group. Students were used to getting immediate feedback from their instructor in the classroom, but they needed to interact with this researcher or their

classmates in the WebCT environment during the experiment. Because students had established their own relationships and interaction patterns, which might not be the same as the experiment design, this situation might also explain their frustration.

On the other hand, students' frustration did not become a factor in influencing students' learning achievement. The possible reasons are as follows:

Students who felt comfortable toward computer technology might also feel frustrated because of the change in the modality or the interaction patterns. Therefore, this variance in comfort level might explain why students' attitudes toward computer technology was statistically significantly different based on their cognitive styles, but the comfort level did not become a factor in influencing students' learning achievement.

#### Hypothesis D

*In online learning environments, there will be a statistically significant difference in students' satisfaction levels between students who received instructions based on their cognitive styles and those who received instructions not based on their cognitive styles (field dependence and field independence).*

By using Two-Way ANOVA, this researcher did not find a statistically significant difference in students' satisfaction levels based on their cognitive styles and treatments. The descriptive data in Table G8 indicated that, however, students in Treatment A were more satisfied than those in Treatment B. The possible reasons are as follows:

For the question in Table G7, one student commented that he only learned Windows Movie Maker in this module; therefore, he didn't think he completely understood video-editing

because there are a lot of video-editing programs on the market. Moreover, this module provided only introductory-level instruction in video-editing. Thus, students might have felt hesitant to respond that they had gained a clear understanding of this subject matter.

Based on the findings in Hypothesis A, students who are FD or FI demonstrated higher knowledge-based learning achievement in Treatment A (FD approach). The findings also supported that because students preferred the instructional design methods provided in Treatment A and had higher satisfaction levels in this treatment, the students demonstrated higher knowledge-based learning achievement.

The findings in Table G8 indicated that the majority of students felt confident creating videos after completing this module, regardless of the cognitive styles. These findings echoed to Chen and Macredie's (2004) empirical study that online learning courseware can be an effective learning platform to accommodate students with different cognitive styles.

## Conclusions

This study was designed to examine the effect of cognitive styles, specifically field dependence-independence, on completing visually-oriented tasks in an online environment. The findings revealed that students favored the treatment that emphasized an FD approach, and students from both cognitive styles performed equally well in online learning environments. Based on the findings and discussions, the conclusions in this study can be summarized to four themes: Cognitive styles and the treatments, effective elements, predictors of students' learning achievement, and students' attitudes.

### *Cognitive styles and the treatments*

The findings in this study supported those in the literature review; students from both FD and FI cognitive styles performed equally well in online learning environments. In addition, for providing introductory-level instruction on visually-oriented tasks in online learning environments, instructions which emphasized an FD approach could accommodate and benefit both FI and FD students in their knowledge-based learning achievement.

### *Effective elements*

By reviewing the components designed in the FD approach, this researcher found that extra cues and sequence of content might have been the reasons that students had higher scores on their knowledge-based learning achievement and satisfaction levels. Moreover, video tutorials might have been an essential element in presenting step-by-step instructions that involved visually-oriented tasks, because mouse movements presented in the video tutorials were not easy to describe in written instructions.

The findings in this study also revealed that FI students would have liked to have more flexibility provided in the instructions to explore or develop their creativity. On the contrary, FD students preferred more guidance and visual cues to keep them on the right track. For future research, a map or a flowchart that indicates the relationship between the tasks in the assignment and the instructions might guide FD students on the right track and provide a global view of the module. This map or flowchart might also help FI students skip what they have already learned and instead focus on what they need to learn to complete the tasks.

In terms of navigation, because this module was straight forward and provided an introductory-level instruction in online learning environments, the Table of Contents function in WebCT can meet both FD and FI students' navigation needs. More navigation functions might favor students from both cognitive groups; however, FD students might get confused more because of the varied navigation functions. In addition, the Table of Contents might need to be set as a separate page to have a larger portion of screen in which to place the content of the module. Students needed to open WebCT and the Windows Movie Maker application at the same time; therefore, if a larger portion of the content could be presented on the screen, then the time students need to flip back and forth between applications would be reduced.

#### *Predictors of students' learning achievement*

The findings of this study supported the research that students' prior knowledge had a statistically significant relationship with students' performance-based learning achievement. Furthermore, the content factor of students' online learning experiences within the module had a statistically significant relationship with students' knowledge-based learning achievement. This finding also indicated that students could demonstrate higher knowledge-based learning achievement scores if they felt the instructions were easy to follow and the workload of the module was manageable.

#### *Students' attitudes*

The findings revealed that students expressed high frustration during the experiment. Participants' generation, modality, and the change in students' interaction pattern might be the



main reasons that students felt frustrated with the module. This situation might also have affected students who felt comfortable toward computer technology. Therefore, even though FI students felt more comfortable toward computer technology, their comfort levels did not impact their learning achievement.

### Recommendations

Based on the findings and conclusions, the recommendations for future studies are listed below:

1. The questions (variables) in the questionnaire related to the content, navigation, and the modality components were grouped into two factors that were not the same as this researcher originally intended. The differences might be due to the statistical fluctuation. A more extensive analysis of the reliability and validity of the questionnaire is needed to extend its application beyond the findings in this study.
2. A number of students read the assignment first, followed by the instructions which were related to the assignment. To provide a map or flowchart that connects the tasks in the assignment with the instructions might enhance students' learning achievement.
3. Students' frustration levels might be different if the population comes from a World Wide Web section instead of a Web-enhanced section. Future studies should consider delivering the same treatment in a World Wide Web mode to examine the differences.

4. Students' frustration levels might be different if the population comes from an older generation group. An older generation should be considered in future studies.
5. In this study, student-to-student and teacher-to-student interactions might affect students' learning achievement. Future studies should consider those interactions as factors and examine their effect on students' learning achievement.
6. A larger sample size is needed to generalize the findings in this study.

**APPENDIX A**  
**COMPUTER TECHNOLOGIES IN EDUCATION SURVEY (ATTITUDE**  
**PRETEST)**

**COMPUTER TECHNOLOGIES IN EDUCATION SURVEY (ATTITUDE PRETEST)**  
(Delcourt & Kinzie, 1993. Adapted with permission)

This test will only allow you to test once. However, if you encounter any network problems during the test and cannot finish it, please contact Jia-Ling Lee by email to reset your test.

The purpose of this survey is to find out how people feel about computer technologies.

Within this survey, the term computer technologies are defined as the use of computers and related hardware and software to perform specific tasks. In the field of education, computer technologies are most often used for: Word processing (e.g., WordPerfect, AppleWorks), communicating with others (e.g., electronic mail, bulletin boards), and searching data bases (e.g., ERIC). When responding to the following statements, consider your use of **any or all** of these technologies.

Results from this survey will be used to help determine the content of future coursework on computer technologies and the way such content will be taught. Your responses are important in making these determinations.

---

**Directions:** This survey has 19 statements about computer technologies. After reading each statement, please indicate the extent to which you agree or disagree, by choosing the statement below to each question. Please respond to all statements. There are no correct or incorrect responses.

---

### Attitudes Toward Computer Technologies

This survey has 19 statements about computer technologies. After reading each statement, please indicate the extent to which you agree or disagree, by circling the number to the right of each sentence. Please respond to all statements. There are no correct or incorrect responses.

	Strongly Disagree	Slightly Disagree	Slightly Agree	Strongly Agree
1. I don't have any use for computer technologies on a day-to-day basis.	1	2	3	4
2. Communicating with others over a computer network can help me to be a more effective teacher.	1	2	3	4
3. I am confident about my ability to do well in a course that requires me to use computer technologies.	1	2	3	4
4. Using computer technologies in my job will only mean more work for me.	1	2	3	4
5. I do not think that computer technologies will be useful to me as a teacher.	1	2	3	4
6. I feel at ease learning about computer technologies.	1	2	3	4
7. With the use of computer technologies, I can create instructional materials to enhance my				

	teaching.	1	2	3	4
8.	I am not the type to do well with computer technologies.	1	2	3	4
9.	If I can use word processing software, I will be a more productive teacher.	1	2	3	4
10.	Anything that computer technologies can be used for, I can do just as well some other way.	1	2	3	4
11.	The thought of using computer technologies frightens me.	1	2	3	4
12.	Computer technologies are confusing to me.	1	2	3	4
13.	I could use computer technologies to access many types of information sources for my work.	1	2	3	4
14.	I do not feel threatened by the impact of computer technologies.	1	2	3	4
15.	I am anxious about computers because I feel like I might break them.	1	2	3	4
16.	Computer technologies can be used to assist me with classroom management techniques.	1	2	3	4
17.	I don't see how computer technologies can help me learn new skills.	1	2	3	4
18.	I feel comfortable about my ability to work with computer technologies.	1	2	3	4
19.	Knowing how to use computer technologies will not be helpful in my future teaching.	1	2	3	4

---

**APPENDIX B**  
**PRETEST and POSTTEST (VERSION A)**

**Question 1** (5.00 points)

What kind of equipment is **NOT** required to run Windows Movie Maker?

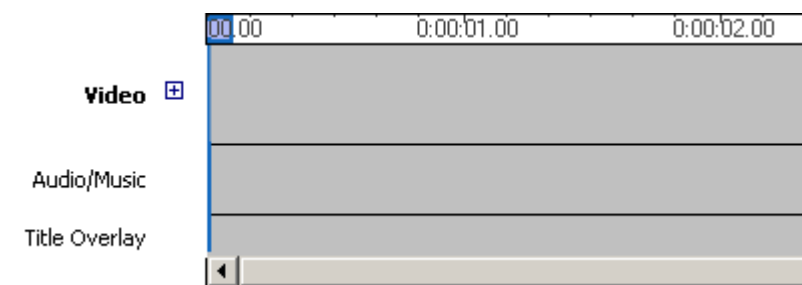
- a. 2 GB of free hard disk space
- b. 128 MB of RAM
- c. Audio capture device
- d. Windows 2000 edition

**Question 2** (5.00 points)

What is the name of the place in Windows Movie Maker, where common functions can be performed to create a movie?

- a. Common pane
- b. Movie tasks pane
- c. Monitor pane
- d. Content pane

**Question 3** (5.00 points)



What is the name of the following element found in Windows Movie Maker?

- a. Editing
- b. Timeline
- c. Storyboard

**Question 4** (5.00 points)

A kind of phenomenon occurs every time an analog recording is copied; some values are lost in the copying process. Each copy (especially a copy of a copy) represents a later, lower-quality generation of the original. What is the name for the phenomenon?

- a. creational loss
- b. quality loss
- c. generational loss
- d. copy loss

**Question 5** (5.00 points)

What is the correct way to express timecode in Windows Movie Maker?

- a. 20:10:05:10
- b. 30:20:10;70
- c. 30:20:30.20
- d. 40;20;58;20

**Question 6** (5.00 points)

Digital data is presented in 0 and 1 format.

- a. True
- b. False

**Question 7** (5.00 points)

Please click [HERE](#) to download the movie and identify what kind of transition is used.

- a. Bar
- b. split, horizontal
- c. Fade
- d. Dissolve

**Question 8** (5.00 points)

What is the video type **NOT** accepted by Windows Movie Maker?

- a. avi
- b. mpg



- c. wmv
- d. mov

**Question 9** (5.00 points)

Which icon is the symbol for video effect used in Windows Movie Maker?



**Question 10** (5.00 points)

What is the common image ratio (or aspect ratio) used in Film?

- a. 16:9
- b. 4:3
- c. 25:29
- d. 1:1

**Question 11** (50 points)

You will be asked to create a **thirty to forty-second movie** called "**Music Party**" for this module. The requirements and grading criteria are as follows:

Requirements	Grading Points
You can either use your own footage or the <a href="#">video source.zip</a> file provided in this module to complete this assignment (Click <a href="#">HERE</a> for the instruction to extract a zip file).	5
Please submit (1) your project file (your file name. <b>mswmm</b> ) that exported the movie and (2) the movie	5
The requirements for this movie are below:	
This movie needs to be exported as <b>.wmv</b> file and the setting should be <b>Video for broadband (512 kbps)</b>	5
This movie needs to have: A title ( <b>Music Party</b> )	5
at least three video clips	5
at least one video effect	5
at least one transition	5
at least one audio clip	5
at least one picture	5
a credits page (please put your name and production date)	5
<b>Total Credits</b>	<b>50</b>

---

**How to submit your movie and due date**

- Please submit your movie through course mail in this course account.
- The due date of this movie is **Nov. 13, 2005 11:55 PM**, please make this movie before reading any content module!

**Example**

- Please click [HERE](#) to watch the example of the movie.
- a. Yes, I will create the movie and send the project file and the movie through course mail in this course account by Nov. 13, 2005 11:55pm.
  - b. No, I do not know how to create the movie for this test.

**APPENDIX C**  
**PRETEST and POSTTEST (VERSION B)**

**Question 1 (5.00 points)**

What kind of equipment is **NOT** required to run Windows Movie Maker?

- a. Apple computer
- b. 2 GB of free hard disk space
- c. Audio capture device
- d. Windows XP Home edition

**Question 2 (5.00 points)**

Please click [HERE](#) to download the movie and identify what kind of transition is used in this movie

- a. Split, horizontal
- b. Fade
- c. Dissolve
- d. Bar

**Question 3 (5.00 points)**

The quality of digital data will be diminished with each copy you make.

- a. True
- b. False

**Question 4 (5.00 points)**

What kind of technique can be used to play audio or video data before the entire file has been transmitted? This technique has developed because most internet users do not have fast enough access to download large video or audio files.

- a. Mpeg
- b. S-VCD
- c. Streaming
- d. DVD

**Question 5 (5.00 points)**

Analog data is recognized by 0 and 1 format

- a. True
- b. False

**Question 6** (5.00 points)



What is the name of the following element found in Windows Movie Maker?

- a. Editing
- b. Timeline
- c. Storyboard

**Question 7** (5.00 points)

What is the audio type **NOT** accepted by Windows Movie Maker?

- a. wav
- b. mp3
- c. cda
- d. snd

**Question 8** (5.00 points)

Which icon is the symbol for video transition used in Windows Movie Maker?



**Question 9** (5.00 points)

What is the common image ratio (or aspect ratio) used in TV?

- a. 16:9
- b. 4:3
- c. 1:1
- d. 25:29

**Question 10** (5.00 points)

Where is the place that Windows Movie Maker organizes footage?

- a. Bin
- b. Sequence
- c. Box
- d. Collections

**Question 11** (50 points)

You will be asked to create a **thirty to forty-second movie** called "**Music Party**" for this module. The requirements and grading criteria are as follows:

Requirements	Grading Points
You can either use your own footage or the <a href="#">video source.zip</a> file provided in this module to complete this assignment (Click <a href="#">HERE</a> for the instruction to extract a zip file).	5
Please submit (1) your project file (your file name. <b>mswmm</b> ) that exported the movie and (2) the movie	5
The requirements for this movie are below:	
This movie needs to be exported as <b>.wmv</b> file and the setting should be <b>Video for broadband (512 kbps)</b>	5
This movie needs to have: A title ( <b>Music Party</b> )	5
at least three video clips	5
at least one video effect	5
at least one transition	5
at least one audio clip	5
at least one picture	5
a credits page (please put your name and production date)	5
<b>Total Credits</b>	<b>50</b>

---

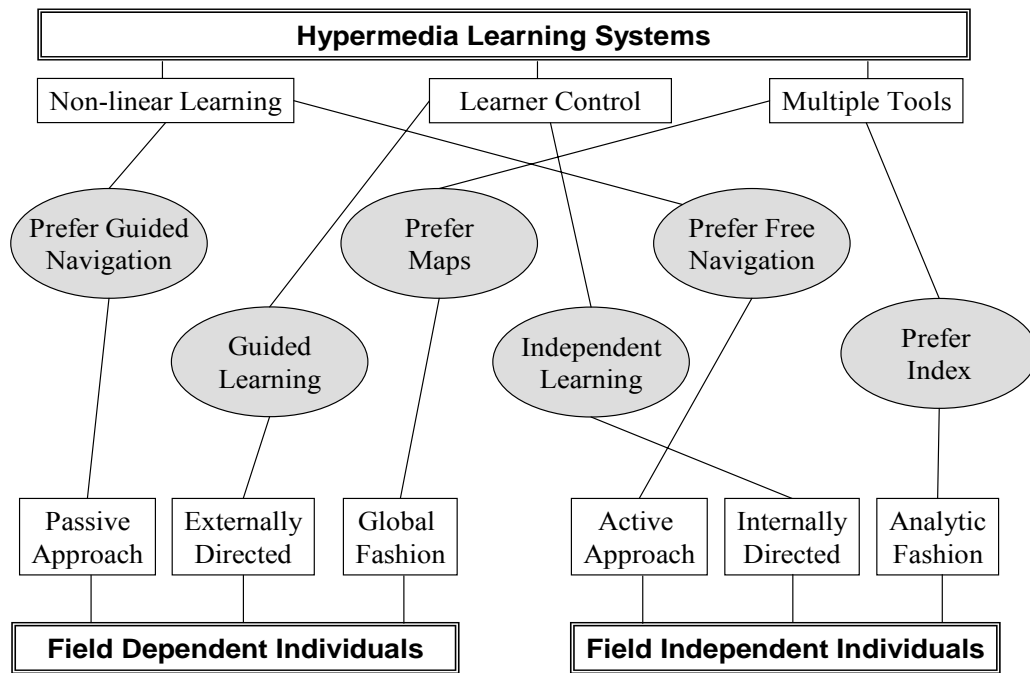
**How to submit your movie and due date**

- Please submit your assignment to the **Dropbox** of this course account.
- The due date of this assignment is **Nov. 20, 2005 11:55 PM**  
**Example**
- Please click **HERE** to watch the example of the movie.

**APPENDIX D**  
**CHARACTERISTICS AND LEARNING PATTERNS OF FIELD-  
DEPENDENT AND FIELD-INDEPENDENT INDIVIDUALS**

## CHARACTERISTICS AND LEARNING PATTERNS OF FIELD-DEPENDENT AND FIELD-INDEPENDENT INDIVIDUALS

(Chen and Marcredie, 2002. Adapted with permission)





**APPENDIX E**  
**EXAMPLES OF TREATMENTS**

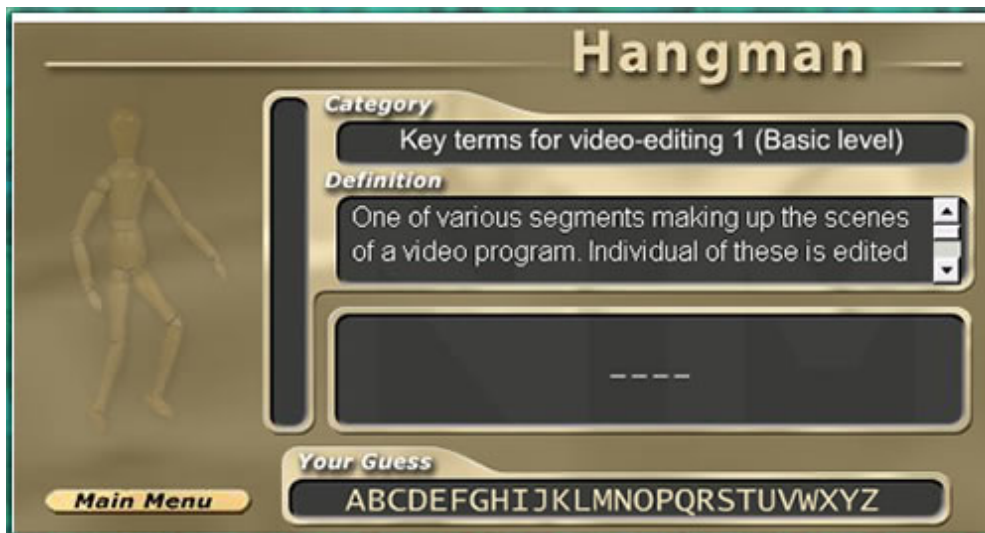
An example of the guided navigation for FD approach (Treatment A)

The screenshot shows a course page titled "eme2040o: Introduction To Educational Tech". At the top, there is a breadcrumb trail: "Homepage > Content Module > Understand the digital video". Below this is a navigation bar with icons for a table of contents, a document, a folder, a folder with a document, and a folder with a document and a folder, followed by links for "Quiz | Glossary | Bookmarks | Discussions | Mail". A yellow box labeled "Action Menu" points to this navigation bar. On the left, a "Table of Contents" section is highlighted with a yellow box and labeled "Table of Contents". It lists "Unit 1 - Are you ready for video?" with sub-items: "Overview and Intro", "Understand key terms of digital video", "Get your computer ready for video", "Understand video and audio", "Understand the digital video", "Hands-On Activity Part I" (with a red star icon), "Overview", "Introduce the working environment", "Capture video and import files", and "Edit your movie". On the right, there is a graphic with the text "Introduction to Video" and "eme2040o" below it.


An example of the navigation icon for FD approach (Treatment A)

The screenshot shows a video practice activity page. At the top left, there is a "Do This!" navigation icon (a hand pointing to a star) highlighted with a yellow box and labeled "Navigation icon". The main heading is "Practice: Video effects activity". Below this, the text reads: "Add **Hue**, add the **Cycles Entire Color Spectrum** effect for video1 and the **Oldest** effect for video2. If you did it successfully, you should see the result of combining the video transition and effects." Below the text are two video thumbnails: "video1" showing a blue abstract pattern and "video2" showing a yellow abstract pattern. At the bottom, there is a link: "Click [HERE](#) to see the result of combining the video transition and effects."

**An example of the hangman game for FD approach (Treatment A)**




**An example of a step-by-step procedure for FD approach (Treatment A)**

 **Practice: Step-by-step procedures to import files**

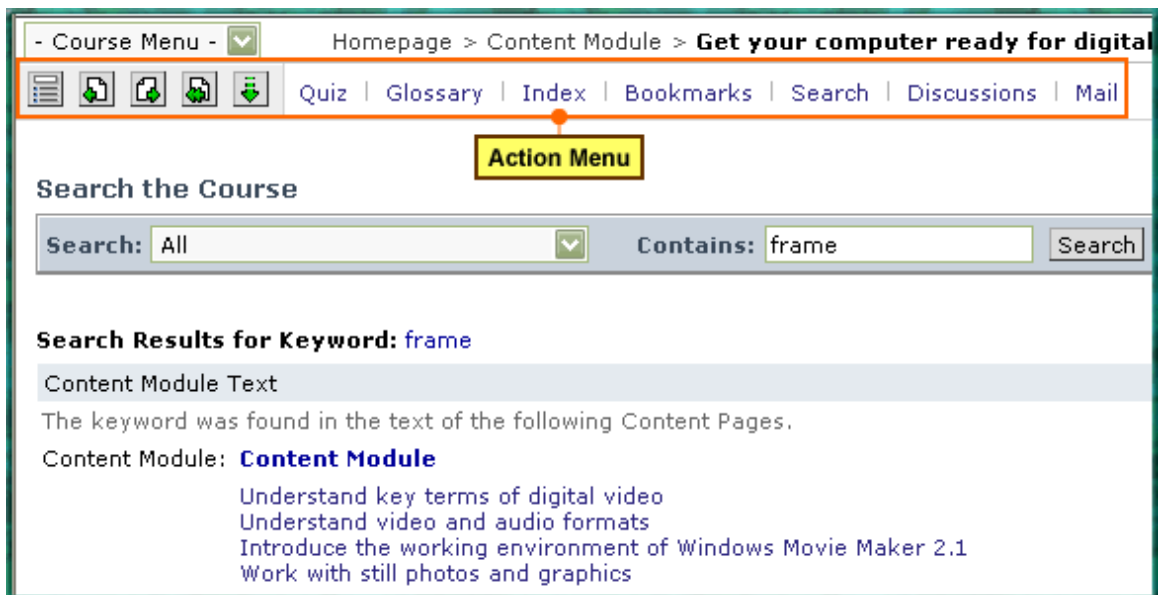
There are two ways to import files:

**Option one:**

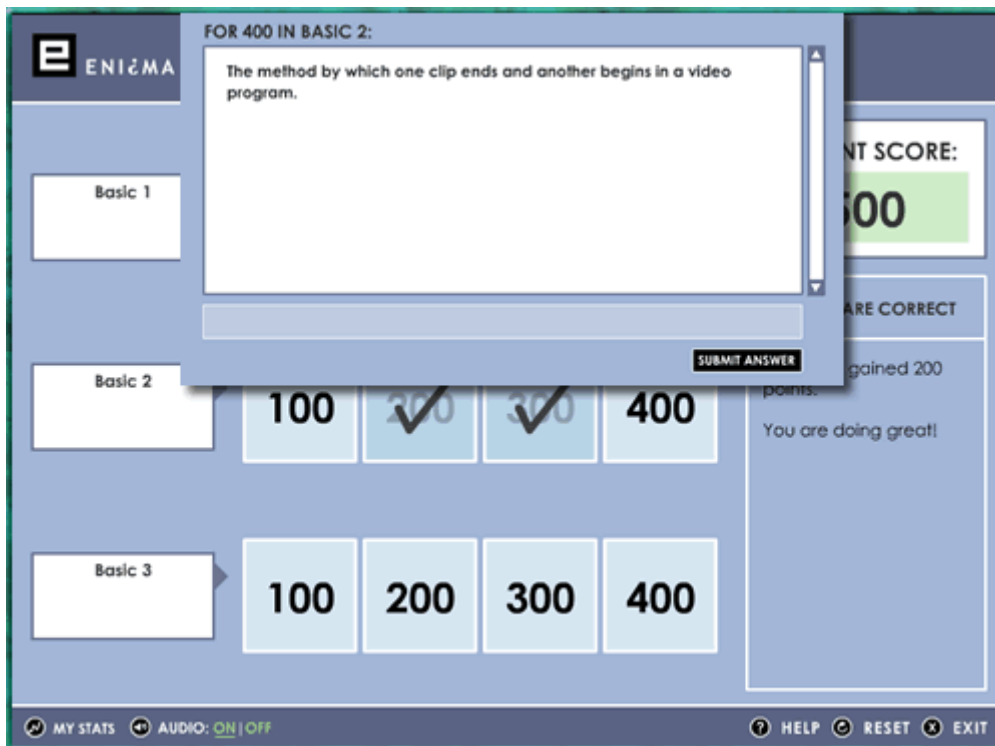
- **Step one:** Click the **File** drop-down menu on the Menu bar
- **Step two:** Choose **Import into collections** from the drop-down menu
- **Step three:** Select the files you want to import from the Import files window, then click the **Import** button



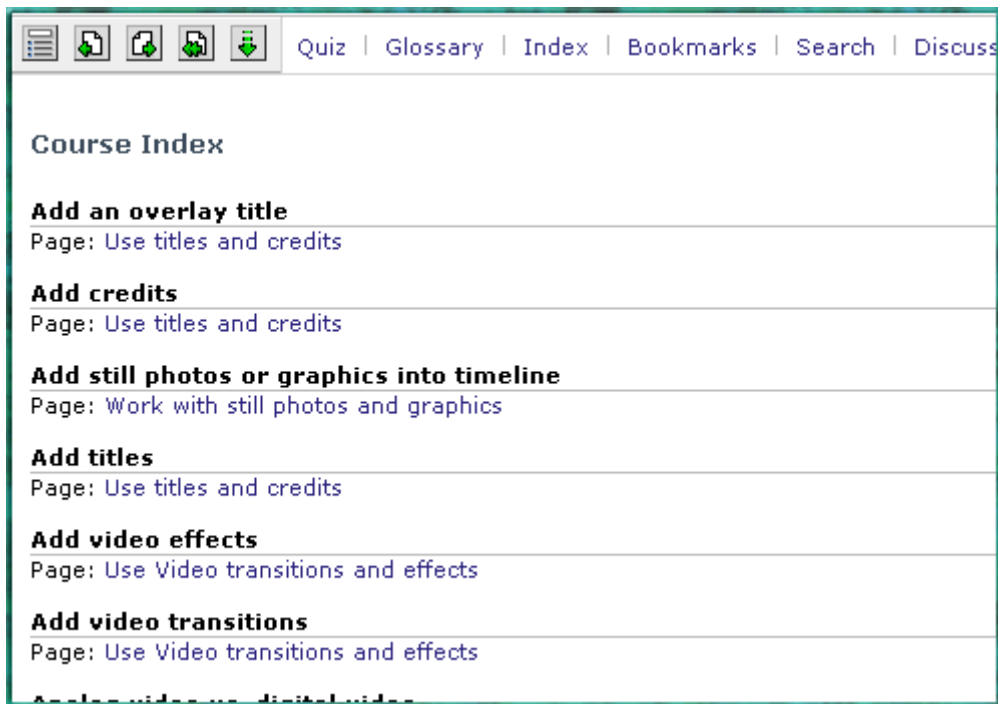
### An example of the search feature for FI approach (Treatment B)



### An example of the Enigma game for FI approach (Treatment B)



## An example of the index feature for FI approach (Treatment B)



The screenshot shows a web interface for a course index. At the top, there is a navigation bar with icons for a menu, home, and other functions, followed by text links for "Quiz", "Glossary", "Index", "Bookmarks", "Search", and "Discuss". Below the navigation bar, the page is titled "Course Index". The index consists of several entries, each with a bold heading and a corresponding page reference:

<b>Add an overlay title</b>	Page: <a href="#">Use titles and credits</a>
<b>Add credits</b>	Page: <a href="#">Use titles and credits</a>
<b>Add still photos or graphics into timeline</b>	Page: <a href="#">Work with still photos and graphics</a>
<b>Add titles</b>	Page: <a href="#">Use titles and credits</a>
<b>Add video effects</b>	Page: <a href="#">Use Video transitions and effects</a>
<b>Add video transitions</b>	Page: <a href="#">Use Video transitions and effects</a>
<b>Assemble videos as digital videos</b>	

**APPENDIX F**  
**QUESTIONNAIRE**

To what extent do you think the following statements are the best choice to describe your situation? Please select one answer for each statement below:

**Title: Q1**

1. How much time did you spend completing this two-week module?

- a. 1-3 hours
- b. 4-6 hours
- c. 7-10 hours
- d. more than 11 hours

**Title: Q2 (content +)**

2. Please evaluate the following statement: The instructions for this video-editing module were easy to follow.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q3 (navigation +)**

3. Please evaluate the following statement: I like the fact that this module allowed me to learn topics in any sequence.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q4 (content -)**

4. Please evaluate the following statement: The workload of this module was too heavy for me.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q5 (mode +)**

5. Please evaluate the following statement: I felt comfortable when this module changed from face-to-face to online delivery mode.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q6 (navigation -)**

6. Please evaluate the following statement: I was confused as to which options to select, because this module provided too many selections.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q7 (content -)**

7. Please evaluate the following statement: I would like this module to have more detailed explanations.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q8 (navigation +)**

8. Please evaluate the following statement: I like the fact that this module allowed me to work at my own pace and direction.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree



- d. Somewhat Agree
- e. Strongly Agree

**Title: Q9 (content -)**

9. Please evaluate the following statement: The content of the module is mumbo jumbo.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q10 (navigation -)**

10. Please evaluate the following statement: I did not know where to go when reading this module.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q11 (mode -)**

11. Please evaluate the following statement: I would rather to learn this module in face-to-face meetings than in the WebCT environment.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q12 (content +)**

12. Please evaluate the following statement: I have gained a clear understanding of video-editing by learning from this module.

- a. Strongly Disagree

- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q13 for FD**

13. What functions below have you used during this module? (You can choose more than one answer)

- A. None (Please skip the question 14)
- B. Table of Content
- C. Hangman Game
- D. The Search function at Action Menu
- E. The Glossary function at Action Menu

**Title: Q14 for FD**

14. What functions below did you find the most useful?

- A. None
- B. Table of Content
- C. Hangman Game
- D. The Search function at Action Menu
- E. The Glossary function at Action Menu

**Title: Q15**

15. Did you encounter any technical difficulty during this module? If yes, please describe it and explain how you solved it.

**Title: Q16**

16. What did you like most about this module?

**Title: Q17**

17. What did you like least about this module?

**Title: Q18 (content +)**

18. Please evaluate the following statement: After completing this module, I can easily use my knowledge to create a movie clip.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q19**

19. Your suggestions are very important to us. Please share any additional comments you have in the box provided below. Feel free to use this space to elaborate on any of your previous answers.

**Title: Q20**

20. What is your gender?

- a. Male
- b. Female

**Title: Q21**

21. What is your age range?

- a. 18-20
- b. 21-23
- c. 24-26
- d. 27-29
- e. 30-40
- f. over 41

**Title: Q22**

22. What is your ethnicity?

- a. Asian/Pacific or Islander
- b. Hispanic
- c. African American
- d. Caucasian

**Title: Q23**

23. Please choose your current status:

- a. Undergraduate: 1 year
- b. Undergraduate: 2 year
- c. Undergraduate: 3 year
- d. Undergraduate: 4 year
- e. Graduate: Post-Baccalaureate
- f. Graduate: Master
- g. Graduate: Specialist
- h. Graduate: Doctor

**Title: Q24**

24. What is your major? (if one has been declared):

**Title: Q25**

25. How much time did you spend on computers during the last week?

- a. less than 5 hours
- b. 5-10 hours
- c. 11-15 hours
- d. More than 15 hours

**Title: Q26**

26. Where did you spend the most time completing this module?

- a. Computers at home
- b. Computers at UCF
- c. Computers at work
- d. Others

**Title: Q27**

27. Before taking this course, how many computer application courses have you taken before?

- A. None
- B. 1-2

- C. 3-4
- D. 5 or more

**Title: Q28**

28. Before taking this course, how many courses have you taken before that used WebCT?

- A. None (Please skip the question 28)
- B. 1-2
- C. 3-4
- D. 5 or more

**Title: Q29**

29. If you have taken courses that used WebCT before, which type of online courses in WebCT did you take the most?

- A. E course (instructors did not reduce class meeting time)
- B. M course (Instructors reduced the class meeting time and students need to study some instructions online)
- C. W course (There is no class meeting except orientation and exams. All class activities are online)

**Title: Q30 (content +)**

30. Please evaluate the following statement: I think that this module was designed based on my cognitive style.

- a. Strongly Disagree
- b. Somewhat Disagree
- c. Neither Agree nor Disagree
- d. Somewhat Agree
- e. Strongly Agree

**Title: Q13 for FI**

13. What functions below have you used during this module? (You can choose more than one answer)

- A. None (Please skip the question 14)
- B. Table of Content
- C. The Index function at Action Menu
- D. The Search function at Action Menu
- E. The Glossary function at Action Menu
- F. The Enigma game

**Title: Q14 for FI**

14. What functions below did you find the most useful?

- A. None
- B. Table of Content
- C. The Index function at Action Menu
- D. The Search function at Action Menu
- E. The Glossary function at Action Menu
- F. The Enigma game

**APPENDIX G**  
**TABLES OF DESCRIPTIVE DATA**

Table G 1  
Demographic Data for Students with FI and FD Cognitive Styles I

Variables	Response Selected	Treatment A (N = 25) (FD approach)				Treatment B (N = 25) (FI approach)			
		FD		FI		FD		FI	
		n	%	n	%	n	%	n	%
Age	18-20	9	81.8	11	78.6	7	53.8	10	83.3
	21-23			2	14.3	5	38.5	2	16.7
	27-29	1	9.1	1	7.1				
	30-40	1	9.1			1	7.7		
Gender	Male	1	7.1	5	35.7	2	14.3	6	42.9
	Female	11	28.9	9	23.7	11	28.9	7	18.4
Race	Asian/Pacific or Islander	1	9.1						
	Hispanic	2	18.2			2	15.4	2	16.7
	African American	1	9.1			1	7.7		
	Caucasian	7	63.6	14	100.0	10	76.9	10	83.3
Status	Undergraduate: 1 yr.	2	18.2	2	14.3	1	7.7	2	16.7
	Undergraduate: 2 yr.	5	45.5	8	57.1	4	30.8	4	33.3
	Undergraduate: 3 yr.	3	27.3	4	28.6	7	53.8	5	41.7
	Undergraduate: 4 yr.	1	9.1			1	7.7	1	8.3



Table G 2  
Demographic Data for Students with FI and FD Cognitive Styles II

Variables	Response Selected	Treatment A (FD approach)				Treatment B (FI approach)			
		FD		FI		FD		FI	
		n	%	n	%	n	%	n	%
<b>Time spent completing the module</b>	1-3 hours	5	45.5	7	50.0	5	38.5	7	58.3
	4-6 hours	5	45.5	7	50.0	7	53.8	5	41.7
	7-10 hours					1	7.7		
	11 hours or more	1	9.1						
	Total		11	100	14	100	13	100	12
<b>Computer courses taken before</b>	None	3	27.3	2	14.3	4	30.8	5	41.7
	1-2	7	63.6	10	71.4	7	53.8	5	41.7
	3-4	1	9.1	2	14.3	1	7.7		
	5 or more					1	7.7	2	16.7
	Total		11	100	14	100	13	100	12
<b>Courses taken before in WebCT</b>	None	2	18.2	3	21.4	3	23.1	1	8.3
	1-2	5	45.5	6	42.9	2	15.4	5	41.7
	3-4	4	36.4	5	35.7	6	46.2	3	25.0
	5 or more					2	15.4	3	25.0
	Total		11	100	14	100	13	100	12
<b>Type of online course taken most in WebCT</b>	Web-enhanced course	9	90.0	10	76.9	10	83.3	9	81.8
	M course	1	10.0	3	23.1			1	9.1
	W course					2	16.7	1	9.1
	Total		10	100	13	100	12	100	11
<b>Locations to complete module</b>	Home	8	72.7	7	50	7	53.8	9	75
	UCF	3	27.3	7	50	6	46.2	2	16.7
	Others							1	4
	Total		11	100	14	100	13	100	12

Table G3

Descriptive Data for Participants' Knowledge-based Learning Achievement Depending on Their Treatments and Cognitive styles

	<b>Treatment</b>	<b>Cognitive styles</b>	<b>M</b>	<b>SD</b>	<b>N</b>
<b>Pretest</b>	A (FD approach)	FD	17.27	9.05	11
		FI	25.36	6.64	14
		Total	21.8	8.65	25
	B (FI approach)	FD	26.92	6.93	13
		FI	32.73	6.84	11
		Total	29.58	7.36	24
	Total	FD	22.5	9.21	24
		FI	28.6	7.57	25
		Total	25.61	8.88	49
<b>Posttest</b>	A (FD approach)	FD	36.36	10.51	11
		FI	39.64	7.96	14
		Total	38.20	9.12	25
	B (FI approach)	FD	34.23	10.96	13
		FI	37.73	11.7	11
		Total	35.83	11.2	24
	Total	FD	35.21	10.58	24
		FI	38.8	9.68	25
		Total	37.04	10.15	49

Table G4  
 Descriptive Data for Participants' Performance-based Learning Achievement Depending on  
 Their Treatments and Cognitive Styles

	<b>Treatment</b>	<b>Cognitive styles</b>	<b>M</b>	<b>SD</b>	<b>N</b>
<b>Pretest</b>	A (FD approach)	FD	0	0	12
		FI	0	0	14
		Total	0	0	26
	B (FI approach)	FD	0	0	13
		FI	0	0	13
		Total	0	0	26
	Total	FD	0	0	25
		FI	0	0	27
		Total	0	0	52
<b>Posttest</b>	A (FD approach)	FD	43.13	14.03	12
		FI	44.82	5.92	14
		Total	44.04	10.27	26
	B (FI approach)	FD	46.54	5.36	13
		FI	46.73	3.44	13
		Total	46.63	4.41	26
	Total	FD	44.9	10.37	25
		FI	45.74	4.89	27
		Total	45.34	7.94	52

Table G5  
Descriptive Data for Students' Attitudes (Comfort/Anxiety) Toward Computer Technology

<b>Treatment group</b>	<b>Cognitive styles</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>
<b>A (FD approach)</b>	FD	23.33	2.96	12
	FI	24.64	3.34	14
	Total	24.04	3.18	26
<b>B (FI approach)</b>	FD	21.31	3.86	13
	FI	24.92	3.01	13
	Total	23.12	3.86	26
<b>Total</b>	FD	22.28	3.54	25
	FI	24.78	3.13	27
	Total	23.58	3.53	52

Table G6  
Descriptive Data for Students' Attitudes (Computer Usefulness) Toward Computer Technology

<b>Treatment group</b>	<b>Cognitive styles</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>
<b>A (FD approach)</b>	FD	39.33	2.06	12
	FI	39.36	4.57	14
	Total	39.35	3.57	26
<b>B (FI approach)</b>	FD	40.85	8.71	13
	FI	38.77	3.32	13
	Total	39.81	6.54	26
<b>Total</b>	FD	40.12	6.36	25
	FI	39.07	3.95	27
	Total	39.58	5.22	52

Table G7

Analysis of Students' Satisfaction Levels I

**Please evaluate the following statement: I have gained a clear understanding of video-editing by learning from this module.**

Response Selected	Treatment A (N=25)				Treatment B (N=25)			
	FD approach		FI approach		FI approach		FI approach	
	FD	FI	FD	FI	FD	FI	FD	FI
	n	%	n	%	n	%	n	%
Strongly Disagree	1	9.1	4	28.6				
Somewhat Disagree	1	9.1			3	23.1	4	33.3
Neither Agree nor Disagree	4	36.4	2	14.3	1	7.7	1	8.3
Somewhat Agree	3	27.3	6	42.9	7	53.8	4	33.3
Strongly Agree	2	18.2	2	14.3	2	15.4	3	25

Note. No significance: Treatment groups ( $F_{1,46} = .4, p > .05$ ), cognitive styles ( $F_{1,46} = .22, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = .02, p > .05$ ).

Table G8

Analysis of Students' Satisfaction Levels II

**Please evaluate the following statement: After completing this module, I can easily use my knowledge to create a movie clip.**

Response Selected	Treatment A (N=25)				Treatment B (N=25)			
	FD approach		FI approach		FI approach		FI approach	
	FD	FI	FD	FI	FD	FI	FD	FI
	n	%	n	%	n	%	n	%
Strongly Disagree	1	9.1						
Somewhat Disagree			2	14.3	3	23.1	1	8.3
Neither Agree nor Disagree	1	9.1			1	7.7	3	25
Somewhat Agree	4	36.4	5	35.7	6	46.2	3	25
Strongly Agree	5	45.5	7	50	3	23.1	5	41.7

Note. No significance: Treatment groups ( $F_{1,46} = .96, p > .05$ ), cognitive styles ( $F_{1,46} = .47, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = .09, p > .05$ ).

Table G9  
Descriptive Data for Participants' Scores of Satisfaction Levels

Treatment group	Cognitive styles	Mean	SD	N
<b>A</b> <b>(FD approach)</b>	FD	7.45	2.25	11
	FI	7.36	2.20	14
	Total	7.40	2.18	25
<b>B</b> <b>(FI approach)</b>	FD	7.31	1.93	13
	FI	7.50	2.07	12
	Total	7.40	1.96	25
<b>Total</b>	FD	7.38	2.04	24
	FI	7.42	2.10	26
	Total	7.40	2.05	50

Table G10  
Analysis of Students' Modality Factor I

**Please evaluate the following statement: I felt comfortable when this module changed from face-to-face to online delivery mode.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Disagree	1	9.1	2	14.3	1	7.7	1	8.3
Somewhat Disagree	3	27.3	4	28.6	6	46.2	2	16.7
Neither Agree nor Disagree	3	27.3	1	7.1	4	30.8	3	25
Somewhat Agree	3	27.3	6	42.9			3	25
Strongly Agree	1	9.1	1	7.1	2	15.4	3	25

Note. No significance: Treatment groups ( $F_{1,46} = .02, p > .05$ ), cognitive styles ( $F_{1,46} = 1.04, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = 1.04, p > .05$ ).

Table G11

Analysis of Students' Modality Factor II

**Please evaluate the following statement: I would rather to learn this module in face-to-face meetings than in the WebCT environment.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Agree	6	54.5	6	42.9	6	46.2	1	8.3
Somewhat Agree	3	27.3	2	14.3	2	15.4	4	33.3
Neither Agree nor Disagree	1	9.1	3	21.4	1	7.7	4	33.3
Somewhat Disagree			2	14.3	2	15.4	2	16.7
Strongly Disagree	1	9.1	1	7.1	2	15.4	1	8.3

Note. No significance: Treatment groups ( $F_{1,46} = 2.08, p > .05$ ), cognitive styles ( $F_{1,46} = 1.4, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = 0, p > .05$ ).

Table G12

Analysis of Students' Navigation Factor I

**Please evaluate the following statement: I like the fact that this module allowed me to learn topics in any sequence.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Disagree	1	9.1	1	7.1				
Somewhat Disagree			1	7.1				
Neither Agree nor Disagree	2	18.2	4	28.6	2	15.4	4	33.3
Somewhat Agree	6	54.5	5	35.7	7	53.8	6	50.0
Strongly Agree	2	18.2	3	21.4	4	30.8	2	16.7

Note. No significance: Treatment groups ( $F_{1,46} = 1.65, p > .05$ ), cognitive styles ( $F_{1,46} = .79, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = .09, p > .05$ ).

Table G 13

Analysis of Students' Navigation Factor II

**Please evaluate the following statement: I was confused as to which options to select, because this module provided too many selections.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Agree			2	14.3			1	8.3
Somewhat Agree	4	36.4	1	7.1	5	38.5	2	16.7
Neither Agree nor Disagree	3	27.3	2	14.3	3	23.1	3	25.0
Somewhat Disagree	3	27.3	5	35.7	4	30.8	4	33.3
Strongly Disagree	1	9.1	4	28.6	1	7.7	2	16.7

Note. No significance: Treatment groups ( $F_{1,46} = .71, p > .05$ ), cognitive styles ( $F_{1,46} = .28, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = .74, p > .05$ ).

Table G14

Analysis of Students' Navigation Factor III

**Please evaluate the following statement: I like the fact that this module allowed me to work at my own pace and direction.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Disagree								
Somewhat Disagree			1	7.1				
Neither Agree nor Disagree	1	9.1	1	7.1			2	16.7
Somewhat Agree	4	36.4	4	28.6	4	30.8	2	16.7
Strongly Agree	6	54.5	8	57.1	9	69.2	8	66.7

Note. No significance: Treatment groups ( $F_{1,46} = .8, p > .05$ ), cognitive styles ( $F_{1,46} = .47, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = .05, p > .05$ ).



Table G15

Analysis of Students' Navigation Factor IV

**Please evaluate the following statement: I did not know where to go when reading this module.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Agree			2	14.3	1	7.7	1	8.3
Somewhat Agree	4	36.4	1	7.1	1	7.7		
Neither Agree nor Disagree	3	27.3	1	7.1	2	15.4	1	8.3
Somewhat Disagree	2	18.2	5	35.7	3	23.1	5	41.7
Strongly Disagree	2	18.2	5	35.7	6	46.2	5	41.7

Note. No significance: Treatment groups ( $F_{1,46} = 2.3, p > .05$ ), cognitive styles ( $F_{1,46} = .9, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = .26, p > .05$ ).

Table G16

Analysis of Students' Content Factor I

**Please evaluate the following statement: The instructions for this video-editing module were easy to follow.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Disagree	2	18.2	3	21.4			1	8.3
Somewhat Disagree	3	27.3	1	7.1	2	15.4	1	8.3
Neither Agree nor Disagree	1	9.1	3	21.4			1	8.3
Somewhat Agree	4	36.4	3	21.4	7	53.8	3	25.0
Strongly Agree	1	9.1	4	28.6	4	30.8	6	50.0

Note. Significance: Treatment groups ( $F_{1,46} = 5.68, p < .05$ ). No significance: Cognitive styles ( $F_{1,46} = .25, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = .25, p > .05$ ).

Table G17

Analysis of Students' Content Factor II

**Please evaluate the following statement: The workload of this module was too heavy for me.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Agree			1	7.1				
Somewhat Agree	3	27.3			2	15.4	1	8.3
Neither Agree nor Disagree	3	27.3	1	7.1	4	30.8	3	25.0
Somewhat Disagree	4	36.4	1	7.1	3	23.1	4	33.3
Strongly Disagree	1	9.1	11	78.6	4	30.8	4	33.3

Note. Significance: Cognitive styles ( $F_{1,46} = 5.63, p < .05$ ). No significance: Treatment groups ( $F_{1,46} = .07, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = 2.69, p > .05$ ).

Table G 18

Analysis of Students' Content Factor III

**Please evaluate the following statement: I would like this module to have more detailed explanations.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Agree	2	18.2						
Somewhat Agree	5	45.5	5	35.7	7	53.8	3	25.0
Neither Agree nor Disagree	2	18.2	1	7.1	2	15.4	4	33.3
Somewhat Disagree	1	9.1	4	28.6	2	15.4	4	33.3
Strongly Disagree	1	9.1	4	28.6	2	15.4	1	8.3

Note. Significance: Cognitive styles ( $F_{1,46} = 4.24, p < .05$ ). No significance: Treatment groups ( $F_{1,46} = .11, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = 1.16, p > .05$ ).

Table G19

Analysis of Students' Content Factor IV

**Please evaluate the following statement: The content of the module is mumbo jumbo.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Agree			2	14.3			1	8.3
Somewhat Agree			1	7.1	3	23.1	1	8.3
Neither Agree nor Disagree	6	54.5	4	28.6	4	30.8	2	16.7
Somewhat Disagree	5	45.5	3	21.4	2	15.4	4	33.3
Strongly Disagree			4	28.6	4	30.8	4	33.3

Note. No significance: Treatment groups ( $F_{1,46} = .37, p > .05$ ), cognitive styles ( $F_{1,46} = .08, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = .13, p > .05$ ).

Table G20

Analysis of Students' Content Factor V

**Please evaluate the following statement: I think that this module was designed based on my cognitive style.**

Response Selected	Treatment A (N=25) (FD approach)				Treatment B (N=25) (FI approach)			
	FD		FI		FD		FI	
	n	%	n	%	n	%	n	%
Strongly Disagree	2	18.2	3	21.4			2	16.7
Somewhat Disagree	1	9.1	2	14.3	2	16.7	1	8.3
Neither Agree nor Disagree	4	36.4	4	28.6	7	58.3	6	50.0
Somewhat Agree	2	18.2	5	35.7	2	16.7	3	25.0
Strongly Agree	2	18.2			1	8.3		

Note. No significance: Treatment groups ( $F_{1,46} = .04, p > .05$ ), cognitive styles ( $F_{1,46} = .99, p > .05$ ), and the interaction between the treatment groups and cognitive styles ( $F_{1,46} = 0, p > .05$ ).

Table G 21

Descriptive Data for How Many Discussion Posting Had Been Read by Students.

<b>Treatment</b>	<b>Cognitive Style</b>	<b>Mean</b>	<b>SD</b>	<b>N</b>
<b>A</b> <b>(FD approach)</b>	FD	5.83	7.40	12
	FI	7.14	7.81	14
	Total	6.54	7.50	26
<b>B</b> <b>(FI approach)</b>	FD	4.00	2.71	13
	FI	1.92	3.01	13
	Total	2.96	3.00	26
<b>Total</b>	FD	4.88	5.44	25
	FI	4.63	6.46	27
	Total	4.75	5.94	52

Note. This researcher made eight announcements in each treatment group. Treatment A had twelve more discussion postings related to students' questions and this researcher's replies.

**APPENDIX H**  
**IRB APPROVAL FORM**



Office of Research & Commercialization

February 17, 2005

Jia-Ling Lee  
1501 River Reach Dr. #275  
Orlando, FL 32828

Ms. Lee:

With reference to your protocol entitled, "Can Cognitive Style Serve as a Good Predictor For Successful Completion of a Visually Oriented Component of Online Instruction" I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office.

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur. Further, should there be a need to extend this protocol, a renewal form must be submitted for approval at least one month prior to the anniversary date of the most recent approval and is the responsibility of the investigator (UCF).

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

*Barbara Ward*

Barbara Ward, CIM  
IRB Coordinator

**APPENDIX I**  
**IRB ADDENDUM/MODIFICATION REQUEST FORM**





**APPENDIX J**  
**FACULTY CONSENT FORM**

## Faculty Consent Form

Please read this consent document carefully before you decide to participate in this study.

**Project title:** THE EFFECT OF COGNITIVE STYLES UPON THE COMPLETION OF A VISUALLY-ORIENTED COMPONENT OF ONLINE INSTRUCTION

**Purpose of the research study:** This study examines the literatures and conducts the experimental research about the relationship between cognitive style (field independent/dependent) and learning performance for a video editing module in higher education.

**What you will be asked to do in the study:** I will design a two-week video editing module and need your permission to put the module into your course; I will also conduct an experimental study in this module and need your students to participate. In addition, I will provide those students consent forms to ask for their participation. There will be no risk or consequence if they decide not to participate. This module will include online materials and activities, a cognitive style instrument, pretest, posttest, and questionnaire. You will also be asked to participate in an interview lasting approximately one hour and to allow observation of your course. Your interview will be conducted at your office or a location of your choice. With your permission, I would like to record your interview.

**Time required:** The online module will take two weeks, students need ten (10) hours per week to complete the study. In addition, they need about 30 minutes in face-to-face meeting to fill the consent letter and the cognitive style instrument before the module. The interview will take about one (1) hour.

**Risks:** There are no anticipated risks.

**Benefits / Compensation:** There is no compensation or other direct benefit to you for participation.

**Confidentiality:** The interview tapes will be destroyed after completion of the study and analysis of the data. Only the research team will have access to the tape, which I will personally transcribe. Your confidentiality will be assured by the use of pseudonyms, if requested, and by the elimination of identifying details. Any information obtained in connection with this study that can be identified with you will remain confidential and be disclosed only with your permission. In addition, all materials will be stored in locked filing cabinets.

**Right to withdraw from the study:** Your participation in this study is voluntary. There is no penalty for not participating. In addition, you are free to withdraw your consent to participate and may discontinue your participation in the interview at any time without consequence.

**Whom to contact if you have questions about the study:** Jia-Ling Lee, Graduate Student, Instructional Technology track, School of Education. My address is 1501 River Reach Dr. #275, Orlando, FL, 32828. My phone number is (407)382-9692. My faculty supervisor is Dr. Gary Orwig, Ph.D., Department of Educational Research, Technology and Leadership, The telephone number is: (407)823-5179.

**Whom to contact about your rights in the study:** UCFIRB Office, University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. The phone number is (407) 823-2901.

\_\_\_\_\_ I have read the procedure described above.

\_\_\_\_\_ I voluntarily agree to participate in the procedure.

\_\_\_\_\_ I would like to receive a copy of the final study.

\_\_\_\_\_ I would not like to receive a copy of the final study.

\_\_\_\_\_  
Participant's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Principle Investigator

\_\_\_\_\_  
Date

**APPENDIX K**  
**STUDENT CONSENT FORM**

### Student Consent Form

Please read this consent document carefully before you decide to participate in this study.

10/31/2005

Dear Student:

My name is Jia-Ling Lee and I am a graduate student working under the supervision of faculty member, Dr. Gary Orwig. You are being asked to participate in an experiment designed to gather information on how cognitive style affect learning performance. This research project was designed solely for research purposes and no one except the research team will have access to any of your responses. All responses will be kept confidential. Your identity will be kept confidential using a numerical coding system. With your permission, you might be asked to participate an interview to express your experience with this module. For the interview part, only the research team can access to the tape. At the end of this research (by July, 2006), the tapes will be destroyed.

Your participation in this project is voluntary. You do not have to answer any question(s) that you do not wish to answer. Please be advised that you may choose not to participate in this research, and you may withdraw from the experiment at any time without consequence. Non-participation will not affect your grade. There are no direct benefits or compensation for participation. This experiment will take approximately ten hours per week for two weeks to complete. In addition, you will also need to take about 30 minutes in face-to-face meeting to fill the consent letter and the cognitive style instrument before the module. There are no anticipated risks associated with participation.

If you have any questions or comments about this research, please contact Jia-Ling Lee or my faculty supervisor, Dr. Gary Orwig, Department of Educational Research, Technology and Leadership, Orlando, FL; (407) 823-5179. Questions or concerns about research participants' rights may be directed to the UCFIRB office, University of Central Florida Office of Research, Orlando Tech Center, 12443 Research Parkway, Suite 207, Orlando, FL 32826. The phone number is (407) 823-2901.

Sincerely,

Jia-Ling Lee

\_\_\_\_\_ I have read the procedure described above.

\_\_\_\_\_ I voluntarily agree to participate in the study.

\_\_\_\_\_ I would like to receive a copy of the final study.

\_\_\_\_\_ I would not like to receive a copy of the final study

\_\_\_\_\_/\_\_\_\_\_(print your name here: \_\_\_\_\_ )  
Participant Date

\*\* If you are under 18 years old, please also get signature from your parents or guardian. Thank you,

\_\_\_\_\_/\_\_\_\_\_  
Parent/Guardian Date

**APPENDIX L**  
**IRB CONTINUING APPROVAL LETTER**



Office of Research & Commercialization

January 19, 2006

Jia-Ling Lee  
1501 River Reach Dr. #275  
Orlando, FL 32828

Dear Ms. Lee:

With reference to your protocol #06-3161 entitled, "**The Effect of Cognitive Styles upon the Completion of a Visually-Oriented Component of Online Instruction,**" I am enclosing for your records the approved, expedited document of the UCFIRB Form you had submitted to our office. **This study was approved on 1/17/06. The expiration date will be 1/16/07.** Should there be a need to extend this study, a Continuing Review form must be submitted to the IRB Office for review by the Chairman or full IRB at least one month prior to the expiration date. This is the responsibility of the investigator. **Please notify the IRB office when you have completed this research study.**

Please be advised that this approval is given for one year. Should there be any addendums or administrative changes to the already approved protocol, they must also be submitted to the Board through use of the Addendum/Modification Request form. Changes should not be initiated until written IRB approval is received. Adverse events should be reported to the IRB as they occur.

Should you have any questions, please do not hesitate to call me at 407-823-2901.

Please accept our best wishes for the success of your endeavors.

Cordially,

*Barbara Ward*

Barbara Ward, CIM  
UCF IRB Coordinator  
(FWA00000351, IRB00001138)

Copies: IRB File  
Gary Orwig, Ed.D.

BW:jm

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