1998

Relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning and achievement: a formative evaluation of distance education via Web-based courses

Ching-Chun Shih
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Relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning, and achievement:

A formative evaluation of distance education via Web-based courses

by

Ching-Chun Shih

A dissertation submitted to the graduate faculty

In partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Agricultural Education (Agricultural Extension Education)

Major Professor: Julia A. Gamon

Iowa State University

Ames, Iowa

1998

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This is to certify that the Doctoral dissertation of
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Major Professor

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ABSTRACT

The World Wide Web (WWW) is the latest in a long line of educational technologies, and the list of courses on it is growing daily. Formative evaluations would help educators enhance teaching and learning in Web-based courses. This study analyzed the relationships between student achievement and the following variables: attitudes, motivation, learning strategies, patterns of learning, learning styles, and selected demographics. It was a population study that included 99 students taking two non-major introductory biology courses offered over the WWW by Iowa State University in the fall of 1997. Seventy-four (75%) students completed a learning style test, an on-line questionnaire, and received a grade by the end of the semester. The learning style test was the Group Embedded Figures Test (GEFT), which classified students as either field-dependent or field-independent. The on-line questionnaire consisted of four scales (attitude, motivation, learning strategies, and patterns of learning), whose pilot-test reliabilities ranged from .71 to .91. The selected demographic variables were gender, class level, previous experience in subject area, hours per week studying and working, computer access, and types of students as off-campus, on-campus, or adult students. Over two-thirds of the students taking the Web-based courses were field-independent learners; however, there were no significant differences (.05 level) in achievement by learning style. Also, different backgrounds of students with different learning styles learned equally well in Web-based courses. The students enjoyed the convenience and self-controlled learning pace and were motivated by competition and high expectations in Web-based learning. They used most the learning strategies of finding important ideas from lectures and memorizing key words of important concepts and least the learning strategy of making charts or tables to organize the material. They seemed more
interested in checking their grades than in communicating with the class and instructors via e-mail, discussion netforum or chat netforum. Motivation and learning strategies were the two significant factors that explained more than one-third of student achievement measured by class grade. Educators should assist students in mastering different motivational and learning strategies to help them become self-regulated learners.
CHAPTER I. INTRODUCTION

Introduction

Evaluations of new educational technologies have tended to compare learning outcomes of instructional delivery methods with the hope that the new technology “will be the one to revolutionize learning” (Parson, 1998, p. 2). However, results of these evaluations are often disappointing (Alexander, 1995). In a study that compiled 50 years of research comparing different delivery methods of instruction, Russell (1998) found no significant differences in learning outcomes when looking solely at the medium of delivering instruction. Moreover, Clark (1983, p. 445) stated “media are mere vehicles that deliver instruction but do not influence student achievements any more than the truck that delivers our groceries causes changes in nutrition.” In essence, Alexander (1995) argued that questions about application of new technologies should not be in terms of media. The most important question should be: what is known about the way students learn through the new technology.

Distance education has a long history of applying technologies in delivering instruction through print, audio, video, and computer (Willis, 1994). Print was the first technology being used in distance education with development of correspondence courses created by universities during the middle 1880s (Brown & Brown, 1994). The latest in the long line of learning technologies is the World Wide Web (WWW) (Parson, 1998). Instruction though the WWW could be viewed as distance education on-line (Parson, 1998).

Being a multimedia part of the Internet, the WWW brought a graphical user interface to world wide networking by allowing full integration of color graphics and pictorial
materials of all kinds, text of varying typefaces, animation, full motion video, and high
quality audio (Seguin & Seguin, 1995; Crossman, 1997). As the popularity of the WWW
increased since the 1990s, its use as a method of delivering instruction also grew. The World
Lecture Hall listed almost 700 Web-based courses that were delivered by higher educational
institutions, and this list had been growing daily (Parson, 1998; World Lecture Hall, 1998).
Alexander (1995; p. 3) believed that "the greatest potential of the Web, however, lies in the
fact that we have a chance to learn from the lessons of the previous faded technologies, and
an opportunity to develop new learning experiences for students that have not been possible
before."

Project BIO at Iowa State University started its involvement in this rapidly growing
Web-based instruction business in the fall of 1996. By 1998, Project BIO had developed
eight Web-based courses in Zoology, Genetics, Biochemistry, and Biology. All the Web-
based courses of Project BIO were stand-alone courses in which most course materials and
resources were accessed and delivered by the Internet (Parson, 1998). Basically, the Project
BIO courses included multimedia lectures that could be accessed from the Project BIO Web
site 24 hours a day. The texts and images of the lectures were delivered in HTML
(HyperText Markup Language) format and could be accessed from a Web browser (example:
Netscape Navigator or Microsoft Internet Explorer). Using RealAudio software, the audio
portion could be accessed through hypertext links, which were the links between text and
other media in the lecture Web pages (Alexander, 1995). Students were able to ask questions
and participate in class discussions through interactive Web pages on a program called
ClassNet, developed by the ISU Computation Center. ClassNet was a World Wide Web
server piece of software designed to manage Internet class activities (Iowa State University, 1998). Exams were also given using ClassNet (Project BIO, 1998a).

Project BIO involved biology educators and students at Iowa State University, community colleges, high schools and selected industries in Iowa. High school students in Iowa could take advantage of the "Postsecondary Enrollment Options Act." that allowed students to take a course and have their school district pay the tuition. All the off-campus students registered through Extended and Continuing Education at Iowa State University (Project BIO, 1998b).

To improve or gain accountability for a project such as Project BIO, evaluation is crucial. There are two types of evaluation for educational projects: formative and summative evaluation. A formative evaluation is conducted during the operation of a project and is essential for the development of a program, because decisions are needed to improve and strengthen the project (Worthen, Sanders, & Fitzpatrick, 1997). A summative evaluation is conducted at the end of the project and is important for the accountability of the project (Worthen et al., 1997). At the initial development stage of Project BIO, conducting formative evaluations was needed to obtain more understanding and knowledge about learning and teaching in Web-based courses, and to help assist educators in designing and delivering quality Web-based instruction.

However, Parson (1998) and Alexander (1995) argued that while implementing a new technology for educational projects, educators should evaluate how and why students learn via the new technology so as to help with curriculum and instructional designs. Parson (1998) added that it is important to understand how the new technology can affect learning when it is used by different types of learners.
Identifying students' learning styles helps educators understand how people perceive and process information in different ways. Garger and Guild (1984, p. 11) described learning styles as "...stable and pervasive characteristics of an individual, expressed through the interaction of one's behavior and personality as one approaches a learning task." According to Cano, Garton, and Raven (1992), one of the most widely studied learning style theories contrasts field-dependence and field-independence. The Group Embedded Figures Test (GEFT), a standardized cognitive test, can be administered to determine the preferred learning styles of the learners as either field-dependent or field-independent (Oltman, Raskin, & Witkin, 1971). Literature (Miller, 1997a; Miller & Honeyman, 1996; Raven, Cano, Garton, & Shellhamer, 1993; Witkin, Moore, Goodenough, & Cox, 1977) on learning styles suggests that field-dependent learners tend to approach a problem in a more global way, are socially oriented, prefer collaboration, and are extrinsically motivated. In contrast, field-independent learners tend to approach a problem more analytically, rely on self-structured situations, prefer competition and are intrinsically motivated. Garger and Guild (1984) emphasized that both field-dependent and field-independent people make equally good learners. But because learning styles affect how successfully people learn in specific situations, educators should be sensitive to cognitive style differences (Garger & Guild, 1984).

Learning strategy literature also emphasizes the ways students learn. Based on the assumption that students' learning strategies can be controlled by learners and changed through teaching (Pintrich & Johnson, 1990), Pintrich and his colleagues developed a learning strategy instrument, *Motivation Strategies for Learning Questionnaire* (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991). This instrument includes two main sections:
one on motivation and one on learning strategies. The learning strategies section consists of
two components (cognitive and metacognitive strategies, and resource management
strategies) and eight scales, which are rehearsal, elaboration, organization, critical thinking,
metacognitive self-regulation, time and study environment, effort regulation, and help

Mayer defined learning strategies as “behaviors of a learner that are intended to
manipulate a person’s cognitive processes during learning” (Mayer, 1988; p. 11). According
to Cross and Steadman (1996), cognitive learning strategies are methods learners can use to
improve their understanding, integration, and retention of new information. Learning
strategies include a wide variety of cognitive processes and behavioral skills (Weinstein &
Meyer, 1991). General learning strategy components include rehearsal, elaboration,
organization, comprehension, metacognition, and resource management (Cross & Steadman,

In their study on relationships between learning strategies and learning styles in a
hypermedia environment, Liu and Reed (1994) used the term “patterns of learning” in
discussing learning strategies. In Lui and Reed’s study, patterns of learning were measured
by identifying how often the students accessed different functions in a hypermedia
environment and how long students used the courseware.

Motivation is one main section in the MSLQ (Pintrich, Smith, Garcia, & McKeachie,
1991). Motivation consists of three general components (value, expectancy, and affect) and
six scales (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning
beliefs, self-efficacy for learning and performance, and test anxiety). Motivation is goal-
directed behavior initiated and sustained by expectations (Bandura, 1986). Motivation
influences how and why people learn as well as their performances (Pintrich & Schunk, 1996).

Pintrich's team and other researchers (Bandura, 1986; Pintrich, 1995; Pintrich & Schunk, 1996; Garcia, 1995; Zimmerman, 1989) believed that students may use different motivational strategies in different learning situations and that students are able to learn and become self-regulated learners. Motivational strategies are those strategies students use to cope with the stress and emotions that are generated when they try to overcome failures and become good learners (Garcia, 1995). Moreover, students can be described as self-regulated to the degree that they are motivationally, metacognitively, and behaviorally active participants in their own learning processes (Zimmerman, 1989).

In a study on predicting student success with a learning and study strategies inventory, Hendrickson (1997) found that motivation and attitudes were the best predictors of student grade point average. An attitude is a person's tendency to be "favorable or unfavorable to an object" (Ajzen, 1989, p. 241). The components of an attitude are: affect (judgment of preference), cognition (beliefs regarding the object's attributes), and conation (intention to act in ways relevant to the object) (Canary & Seibold, 1984).

Need for Study

A formative evaluation is conducted during the operation of a program and is essential for the development of a program, because decisions are needed to improve and strengthen the program (Worthen et al., 1997). A formative evaluation is needed to identify learning factors that influence student success in Web-based learning in order to assist in instructional development of the Project BIO program. Additionally, a formative evaluation
is needed to assess the relationships among student attitudes, motivation, learning styles, learning strategies, and patterns of learning in Web-based courses. This type of research will assist educators in planning, organizing, and delivering quality Web-based instruction in a manner that will improve student learning.

Statement of the Problem

The World Wide Web is the latest in a long line of educational technologies, and the list of courses on it is growing daily. Questions about application of new technologies should not be in terms of media. The most important question should be: what do we know about the way students learn via the new technology, WWW? What are the important learning factors which influence student achievement in Web-based courses? Based on the previous literature review, student motivation, learning styles, learning strategies, patterns of learning, and student attitudes seem to be associated with learning achievement. Is this true in Web-based courses? Research is needed to identify the most important learning factors in order to help educators enhance teaching and learning in Web-based courses.

Purpose and Objectives

The purpose of this study was to evaluate how students with different learning styles learned and to identify factors influencing their achievement in Web-based courses. Objectives of the study were to identify:

a) demographic characteristics of the students in relation to their learning styles,

b) how attitudes, motivation, learning strategies, patterns of learning, and achievement differed in relation to students’ learning styles,
c) relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning, achievement, and demographics, and
d) prediction of higher or lower achieving students based on attitudes, motivation, learning styles, learning strategies, patterns of learning, and demographics.

Audience of the Study

Two of the courses pertinent to this study were Zoology 155 and Biology 109 offered through Project BIO at Iowa State University. Typically these classes were taken by freshmen and sophomores at the university. They were also available to high school students who wished to begin taking university courses for advanced placement. Beginning in 1996, these courses were offered on the Web as well as on-campus.

Definition of Terms

For the purpose of this study, the following definitions were used.

1. Attitude: An attitude is a person's tendency to answer favorably or unfavorably to an object, or to any other discriminable aspect of the person's world (Thompson, Higgins, & Howell, 1994).

2. Distance education: "Distance education takes place when a teacher and student(s) are separated by physical distance, and technology ... is used to bridge the instructional gap" (Willis, 1994; p. v).

3. Learning strategies: Learning strategies are methods that a learner uses to improve their understanding, integration, and retention of new information in the learning process (Cross & Steadman, 1996).
4. **Learning styles:** The relatively stable psychological characteristics at the personality level that influence the way learners perceive, organize, and react to different situations (Curry, 1990; Garger & Guild, 1984). The Group Embedded Figures Test (GEFT), a standardized cognitive test, can be administered to determine the preferred learning styles of the learners as either field-dependent or field-independent (Oltman, Raskin, & Witkin, 1971).

5. **Motivation:** Motivation is goal-directed behavior initiated and sustained by expectations concerning the anticipated outcomes of actions and self-efficacy for performing those actions (Bandura, 1986). Motivation can be controlled by learners and changed through instruction (Pintrich & Johnson, 1990).

6. **Motivational strategies:** Motivational strategies are those strategies student use to cope with the stress and emotions that are generated when they try to overcome failures and become good learners (Garcia, 1995).

7. **Patterns of learning:** Patterns of learning indicate how often the students accessed different computer functions in Web-based courses (Lui & Reed, 1994).

8. **Stand-alone courses:** The courses in which most course materials and resources are accessed and delivered by the Internet (Parson, 1998).

9. **Student achievement:** Student achievement is the "performance by a student in a course: quality and quantity of a student's work during a given period" (Gove, 1986, p. 16). In this study, student achievement referred to the grades students earned in their courses.

10. **World Wide Web instruction:** Instruction delivered in whole or in part by the Web (Parson, 1998).
Implications and Educational Significance

This type of research, in the short run, might assist educators in planning, organizing, and delivering quality Web-based instruction in a manner that will improve student learning. In the long run, the findings might emphasize and support the importance of the relationships between and among student motivation, learning strategies, patterns of learning, learning styles, attitude, and educational achievement.

Summary

The latest in the long line of learning technologies is the World Wide Web (WWW). Project BIO at Iowa State University has developed eight WWW courses since 1996. A formative evaluation is needed to identify areas for improvement. While implementing the new technology in educational projects, the most important question about the use of new technology in education is: What is known about the way students learn (Alexander, 1995). The purpose of this study was to evaluate how students with different styles learned and to identify factors influencing their learning in Web-based courses. The learning factors that might influence student achievement are learning styles, learning strategies, patterns of learning, motivation, and attitude. Garger and Guild (1984, p. 11) described learning styles as "...stable and pervasive characteristics of an individual, expressed through the interaction of one's behavior and personality as one approaches a learning task." The Group Embedded Figures Test (GEFT), a standardized cognitive test, can be administered to determine the preferred learning styles of the learners as either field-dependent or field-independent (Oltman, Raskin, & Witkin, 1971). Learning strategies are behaviors or methods that a learner uses to improve their understanding, integration, and retention of new information in
the learning process (Cross & Steadman, 1996). Moreover, patterns of learning focus on
identifying student behaviors regarding how often they access different computer functions.
Motivation is part of the learning process, and it influences how and why people learn as well
as their performance (Pintrich & Schunk, 1996). Student attitudes might also influence
learning. Attitude is an individual's tendency to answer favorably or unfavorably to a
situation (Thompson, Higgins, & Howell, 1994). What do we know about the way students
learn via the new technology, WWW? What are the important learning factors in Web-based
courses? A formative evaluation is needed to identify learning factors that influence student
success in Web-based learning in order to assist in instructional development of Project BIO.
CHAPTER II. LITERATURE REVIEW

Introduction

This literature review is divided into four major sections: (a) attitudes, (b) learning styles, (c) learning strategies and patterns of learning, (d) motivation, and (e) relationships among attitudes, learning styles, learning strategies, patterns of learning, motivation, and student achievement. Each section explains relevant theories and describes related research.

Attitudes

Views of attitudes

An attitude is a person's tendency to be "favorable or unfavorable to an object" (Ajzen, 1989, p. 241). According to Eiser (1984), there are three major features in a person's attitude:

First, an attitude develops through experience with an object. Second, it predisposes one to act in a predictable manner with respect to an object. Third, an attitude consists of positive or negative evaluations. (p. 179)

Two views have dominated understanding of attitude structure and process: The tripartite and expectancy values. The tripartite concept indicates that an attitude is composed of three components that play coextensive and/or substitute roles in determining behavior (Canary & Seibold, 1984). The components are affect (judgment of preference), cognition (beliefs regarding the object's attributes), and conation (intention to act in ways relevant to the object) (Canary & Seibold, 1984; Rosenberg & Hovland, 1960). The second view of attitude, expectancy value, indicated that an attitude was composed of beliefs regarding
possible rewards and costs that result from acting toward the object in particular ways (Ajzen, 1989).

**Research studies related to attitudes**

Six studies related to attitudes (Belcher & McCaslin, 1997; Dyer, 1996c; Deeds, 1991; Miller, 1997d; Peasley & Henderson, 1992; Reaves, 1993) were published in the *Journal of Agricultural Education* between the year of 1989 and 1997. Five of the studies (Belcher & McCaslin, 1997; Dyer, 1996c; Deeds, 1991; Peasley & Henderson, 1992; Reaves, 1993) were related to general education programs. Only one of the studies (Miller, 1997d) was related to distance education.

Miller (1997d) studied Iowa secondary agricultural teachers' attitudes toward the interactive communications network (ICN), a two-way fiber optic telecommunications system. He found that they were concerned about such obstacles as scheduling ICN use and managing laboratory and supervised agricultural experience activities. Their attitude was undecided about ICN's usefulness as a teaching tool.

Three studies related to attitude and distance education were found in the proceedings of the *National Agricultural Education Research Meetings* (Miller, 1997c; Miller & Honeyman, 1996; Raven, Newman, & Day, 1997). In his study on predicting student achievement in agricultural courses delivered by videotape, Miller (1997c) found that high achieving students had a more positive attitude toward videotaped instruction. Furthermore, in their study on the attitudes of students involved in agricultural off-campus videotaped courses, Miller and Honeyman (1996) found that the students were more positive towards videotaped instruction due to the convenience, learning opportunities, and the ability to
control the pace of learning. Likewise, Raven, Newman, and Day (1997) in a study on students' anxiety and attitudes toward computer, found that students improved their attitudes toward computers regardless of their learning styles.

Learning Styles

An indication of the importance of learning styles to the profession (Cano & Garton, 1994; Dyer & Osborne, 1996a; Dyer & Osborne, 1996b; Marrison & Frick, 1994; Miller, 1997b; Miller & Honeyman, 1996; Torres & Cano, 1994; Whittington & Raven, 1995) is the increase in the numbers of the researchers interested in the topic. Fifteen agricultural education studies related to learning styles were published between 1992 and 1997. However, it can be difficult for educators who are interested in using learning style instruments for their research or teaching to make appropriate choices among the diverse instruments available for assessing how individuals learn. The great diversity in these instruments also leads to confusion in terminology, definitions, and conceptualization (Mertesdorf, 1990).

To clarify this situation, Curry (1983) reorganized the learning style instruments into a three-layer model: (a) instructional and environmental learning preferences, (b) information processing learning preferences, and (c) personality related learning preferences. On the other hand, Keefe (1987) proposed a learning style model including three dimensions: (a) cognitive, (b) affective, and (c) physiological. This section of the literature review examines Curry's (1983) and Keefe's (1987) learning style models and the research studies related to learning styles.
Curry’s learning style model

Curry (1983) conducted a psychometric survey of 21 learning style conceptualizations and instruments from North America, Europe, and Australia over a five years period. She found that it was possible to reorganize the 21 learning style instruments into a three-layer model based on psychometric evidence and written documentation. The model has three layers like an onion. The three layers are: (a) learning style as instructional and environmental preferences, (b) learning styles as information processing preferences, and (c) learning style as personality-related preferences (Table 1).

Learning styles as instructional and environmental preferences. The outermost layer of Curry’s model, which is the individual’s preference for instruction and learning environments, is the easiest to observe but hardest to quantify due to the fact that instructional environmental preferences are not stable and are subject to change throughout a person’s life. Hence, measurements are seldom valid or reliable.

Learning styles as information processing preferences. The second or middle layer of the learning style onion model is the individual’s information processing preferences, which refers to the individual’s intellectual approach to assimilating information. Information processing is a set of processes that function at the intersection between fundamental personality levels, individual differences, and environmentally based learning format choices (Curry, 1983). This level of the onion model is considered to be more stable and less likely to change because it does not depend directly on the learning environment.
<table>
<thead>
<tr>
<th>Level of Curry’s Model</th>
<th>Author(s)</th>
<th>Learning Style Inventories</th>
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<tbody>
<tr>
<td>1. Instructional and Environmental</td>
<td>Canfield &amp; Laffert</td>
<td>Learning Style Inventory</td>
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<td>Preference</td>
<td>Dunn, Dunn, &amp; Price</td>
<td>Learning Style Inventory</td>
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<td></td>
<td>Entwistle &amp; Ramsden</td>
<td>Approaches to Studying</td>
</tr>
<tr>
<td></td>
<td>Hunt</td>
<td>Paragraph Completion Method</td>
</tr>
<tr>
<td></td>
<td>Kolb</td>
<td>Learning Style Inventory</td>
</tr>
<tr>
<td></td>
<td>Reinert</td>
<td>Edmonds Learning Style Identification Exercise</td>
</tr>
<tr>
<td></td>
<td>Schmeck, Ribich, &amp;</td>
<td>Inventory of Learning Process</td>
</tr>
<tr>
<td></td>
<td>Ramanaih</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schroeder</td>
<td>Paragraph Completion Test</td>
</tr>
<tr>
<td>3. Personality-Related Preference</td>
<td>Kagan</td>
<td>Matching Familiar Figures Test</td>
</tr>
<tr>
<td></td>
<td>Myers</td>
<td>Myers-Briggs Type Indicator</td>
</tr>
<tr>
<td></td>
<td>Witkin</td>
<td>Embedded Figures Test</td>
</tr>
</tbody>
</table>

**Learning styles as cognitive personality-related preferences.** The third and central layer of the learning style onion model is the cognitive personality-related concept that is defined as an individual’s approach to adapting and assimilating information. This adaptation, which does not interact directly with the environment, is composed of some underlying and personality constructs that are of a relatively permanent nature. The cognitive personality-related style is similar to the information layer, both are considered the most permanent, hardest to observe directly but easiest to quantify because of their stability (Curry, 1983).

**Keefe’s learning style model**

Keefe (1987), looking at learning styles from a perspective that differs from Curry’s model, proposed another learning style model based on different classifications. He defined learning styles as “the characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment” (Keefe, 1987, p. 5). Based on this learning style definition, Keefe designed a learning style model with three aspects: (1) cognitive, (2) affective, and (3) physiological (Table 2). Keefe’s simple aim was to categorize the conceptualizations of learning styles without classifying the measuring instruments into groups.

**Cognitive learning styles.** Cognitive styles are information processing habits representing the learner’s typical mode of perceiving, thinking, problem solving, and remembering (Keefe, 1987). Keefe indicated that the vast majority of research on personality-related learning variables has been in the area of cognition. Each learner has preferred patterns of perception, organization, and retention that are distinctive and
consistent. These characteristic differences are called cognitive styles. Wooldridge (1995) identified five dimensions of cognitive learning styles for improving the learning process as (a) field independent versus dependent, (b) perceptual modality preferences, (c) productivity environmental preference survey, (d) conceptual tempo, and (e) leveling versus sharpening (Table 2).

**Affective learning styles.** Affective learning styles are those dimensions of the individual’s personality that have to do with attention, emotion, and valuing. Keefe (1987, p. 10) stated that “affective learning styles are the offshoots of these same motivational processes viewed as the learner’s typical mode of arousing, directing, and sustaining behavior.” As with cognitive style, affective style is a hypothetical construct. People cannot directly observe affective style; it can only be inferred from a person’s interaction with the environment (Keefe, 1987). Wooldridge (1995) included five dimensions in the affective learning style; they are: (a) conceptual level, (b) locus of control, (c) achievement motivation, (d) social motivation, and (e) masculine-feminine behavior.

**Physiological learning styles.** Physiological learning styles are biologically-based modes of response that are founded on sex-related differences, personal nutrition and health, and accustomed reaction to the physical environment. Physiological factors are among the most evident influences in the process of school learning. The student who is hungry, ill, or malnourished behaves differently from one who is healthy. Males and females respond differently in certain learning situations (Keefe, 1987). Five dimensions of physiological learning styles that were identified by Keefe are: (a) sex-related behavior, (b) health-related behavior, (c) time-of-day rhythms, (d) need for mobility, and (e) environmental elements.
Table 2
Learning Style Instruments Classified by Aspects of Learning Styles

<table>
<thead>
<tr>
<th>Aspects of Learning Styles</th>
<th>Learning Style Instruments</th>
</tr>
</thead>
</table>
| 1. Cognitive Learning Style| • Field Independent versus Dependent (Witkin et al., 1971)  
• Perpetual Modality Preferences (Price, Dunn, & Dunn, 1978)  
• Productivity Environmental Preference Survey (Price, Dunn, & Dunn, 1978)  
• Conceptual Tempo (Kagan, 1966)  
• Leveling versus Sharpening (Holzman & Klein, 1954) |
• Locus of Control (Rotter, 1971)  
• Achievement Motivation (McClelland, 1971)  
• Social Motivation (Hill & Nunnery, 1973)  
• Masculine-Feminine Behavior (MacCoby & Jacklin, 1974) |
| 3. Physiological Learning Styles| • Sex-Related Behavior (MacCoby & Jacklin, 1974; Wittig & Peterson, 1979)  
• Health-Related Behavior (Cravioto, 1971; Dunn & Dunn, 1978)  
• Time-Of-Day Rhythms (Dermer and Berscheid, 1972; Dunn & Dunn, 1978)  
• Need for Mobility (Fitt, 1975; Dunn & Dunn, 1978)  
• Environmental elements (Dunn & Dunn, 1978) |

*Developed based on Keefe (1987) and Wooldridge (1995)*
Research studies related to learning styles

Fifteen studies utilizing 16 learning style instruments were published in the Journal of Agricultural Education between January of 1992 and June of 1997 (Table 3). In ten of the articles, the authors used the Group Embedded Figures Test (GEFT) to assess learning styles; four used the Myers Briggs Type Indicator (MBTI); one used Kolb's Learning Style Inventory (LSI); and another one used Learning Style Profile (LSP).

Table 4 shows how these four learning style instruments fit into Curry’s and Keefe's models. Since LSP was not included in Curry’s onion model (Table 1) and MBTI was not in Keefe’s (Table 2), the researchers classified these two instruments according to the categories of Curry’s and Keefe’s models and the descriptions of the instruments by Keefe (1987), Woodrige (1995), and Hickcox (1995). It seems that most of the learning styles research in Agricultural Education intended to study the most permanent aspects of information processing behavior of learners by using GEFT and MBTI. And GEFT is the instrument most preferred by agricultural education researchers.

**Group Embedded Figures Test.** The Group Embedded Figures Test (GEFT), a standardized instrument, can be administered to determine the dominant learning styles of the learners as either Field-Dependent or Field-Independent (Oltman, Raskin, & Witkin, 1971). Witkin, Moore, Goodenough, & Cox (1977, p. 7) explained “when perception is strongly dominated by the prevailing field (a region, space, or sphere where mental or physical activity exists), that mode of perception is designated as Field-Dependent, but when the person experiences items as more or less separate from the surrounding field, the perception is designated as Field-Independent.” The GEFT measures whether the learner uses an
Table 3
Learning Style Instruments Used by Authors in *Journal of Agricultural Education* Articles (1992-1997)

<table>
<thead>
<tr>
<th>Learning Style Instrument</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Embedded Figures Test (GEFT)</td>
<td>1) Cano, J. (1992)*</td>
</tr>
<tr>
<td></td>
<td>2) Cano, J. &amp; Garton, B. L. (1994b)</td>
</tr>
<tr>
<td></td>
<td>7) Miller, G. (1997b)</td>
</tr>
<tr>
<td>Myers Briggs Type Indicator (MBTI)</td>
<td>1) Cano, J. (1992)*</td>
</tr>
<tr>
<td></td>
<td>2) Cano, J. &amp; Garton, B. L. (1994a)</td>
</tr>
<tr>
<td></td>
<td>4) Rollins, T. J. (1990)</td>
</tr>
<tr>
<td>Kolb’s Learning Style Inventory (LSI)</td>
<td>1) Rollins, T. J. &amp; Yoder, E. P. (1993)</td>
</tr>
<tr>
<td>Learning Style Profile (LSP)</td>
<td>1) Rollins, T. J. (1992)</td>
</tr>
</tbody>
</table>

*Cano, J. (1992)* used both the Group Embedded Figures Test (GEFT) and Myers Briggs Type Indicator (MBTI) in his study.*
Table 4  
Learning Style Instruments Used in Agricultural Education Research as Classified by Curry’s and Keefe’s Models

<table>
<thead>
<tr>
<th>Keefe’s Model</th>
<th>Curry’s Onion Model</th>
<th>Keefe’s Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional and Environmental Preference</td>
<td>Information Processing Preference</td>
<td>Personality Related Preference</td>
</tr>
<tr>
<td>Cognitive Learning Style</td>
<td>Kolb’s LSI</td>
<td>GEFT</td>
</tr>
<tr>
<td></td>
<td>LSP</td>
<td>MBTI</td>
</tr>
<tr>
<td>Affective Learning Style</td>
<td>LSP</td>
<td>MBTI</td>
</tr>
<tr>
<td>Physiological Learning Style</td>
<td>LSP</td>
<td>LSP</td>
</tr>
</tbody>
</table>

“analytical as opposed to a global way of experiencing the environment” (Keefe, 1979, p. 9).

Table 5, developed by Miller and Honeyman (1996), presents the characteristics and behaviors associated with the Field-Dependent and Field-Independent learning styles.

Moreover, several studies (Annis, 1979; Moore & Dwyer, 1992; Ronning, McCurdy, & Ballinger, 1984) have shown that field-independent people tend to outperform field-dependent people in various settings. However, in their study related to the effects of learning styles on achievement in a WWW course, Day, Raven, and Newman (1997) found learning styles had no effect on student achievement or attitude in Web-based instruction, which echoes the findings of the study on learning styles in a hypermedia environment conducted by Liu & Reed (1994).
### Table 5
Characteristics and Behaviors Associated with the Field-Dependent and Field-Independent Learning Styles*

<table>
<thead>
<tr>
<th>Learning Style</th>
<th>Field-Dependent</th>
<th>Field-Independent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Find it difficult to learn when the learning task involves several steps</td>
<td>Able to accomplish learning tasks that involve several steps</td>
</tr>
<tr>
<td></td>
<td>Experience difficulty in problem-solving situations</td>
<td>Good at analytical problem-solving</td>
</tr>
<tr>
<td></td>
<td>Prefer to have answers provided by the instructor</td>
<td>Prefer an inquiry approach to learning</td>
</tr>
<tr>
<td></td>
<td>Prefer externally defined goals and organization</td>
<td>Can provide their own structure for learning activities</td>
</tr>
<tr>
<td></td>
<td>Prefer a spectator approach to learning</td>
<td>Prefer trial and error as opposed to being shown how</td>
</tr>
<tr>
<td></td>
<td>Value positive reinforcement from the teacher</td>
<td>Do not typically respond to positive reinforcement offered by teachers</td>
</tr>
<tr>
<td></td>
<td>Have well-developed social skills and are more attuned to social cues</td>
<td>Have poorly developed social skills and are more socially independent</td>
</tr>
<tr>
<td></td>
<td>Favor extrinsic motivation</td>
<td>Are intrinsically motivated</td>
</tr>
<tr>
<td></td>
<td>Prefer collaboration</td>
<td>Prefer competition</td>
</tr>
</tbody>
</table>

*Developed by Miller and Honeyman (1996)
Learning Strategies and Patterns of Learning

Learning strategies

Learning style literature describes the relatively stable psychological characteristics at the personality level that influence the way learners perceive, organize, and react to different situations (Curry, 1990; Garger & Guild, 1984). In assuming stability as well as lack of individual control, the learning style models suggest that it may be difficult for students to change their learning styles (Pintrich & Johnson, 1990). However, the learning strategy literature is based on the assumption that students' motivation and use of learning strategies can be controlled by learners and changed through teaching (Pintrich, 1990). Moreover, Pintrich (1990) argued that learners might use different learning strategies in different situations.

If learning strategies are different from learning styles, what are learning strategies? Mayer (1988, p. 11) defined learning strategies as "behaviors of a learner that are intended to manipulate a person's cognitive processes during learning." According to Cross and Steadman (1996), cognitive learning strategies are methods learners can use to improve their understanding, integration, and retention of new information. Several researchers indicated that students who use more learning strategies usually learn more than students who use fewer strategies (Pintrich & Johnson, 1990; Weinstein & Underwood, 1985). Instruments of learning strategies have been developed by Weinstein and her colleagues (Weinstein, Palmer, & Schulte, 1987) and Pintrich and his colleagues (Pintrich, Smith, Garcia, & McKeachie, 1991). The next section of the literature review explores the types and models of learning strategies, instruments, patterns of learning, and related research studies.
Types of learning strategies


1. Rehearsal strategies: Many instructional tasks require simple recall or identification of important information. Effective rehearsal strategies are found most frequently in introductory courses because the acquisition of basic knowledge is often a first step in the creation of a more extensive, integrated knowledge base in an area (Weinstein & Meyer, 1991).

2. Elaboration strategies: With elaboration strategies, students make connections with prior knowledge or experience to facilitate what they are trying to learn more meaningful and memorable (Weinstein & Meyer, 1991; Cross & Steadman, 1996).

3. Organization strategies: Requiring the translation or transformation of information into another form, organization strategies provide structure for this new form of information. Organization strategies include outlining information, creating diagrams on related course concepts, or clustering ideas into categories (Weinstein & Meyer, 1991; Cross & Steadman, 1996).

4. Comprehension monitoring strategies: Comprehension monitoring strategies focus one’s attention and prevent mind wandering, and check understanding through self-testing.

5. Metacognition strategies: Metacognition refers to the way students think about themselves as learners and the way they manage their own learning, such as planning, monitoring, and regulating learning (Garcia & Pintrich, 1995). Learners can use metacognitive strategies to detect, monitor, and direct their acquisition of the new information (Weinstein & Underwood, 1985; Cross & Steadman, 1996).

6. Resource management: Resource management strategies are the practical study skills that include setting up a homework schedule and creating a distraction-free study environment (Cross & Steadman, 1996). Learners can use resource management strategies to manage their time and their study environments (Pintrich & Johnson, 1990).

**Learning strategies models and instruments**

Many different models of learning strategies are appropriate to college education (McKeachie, Pintrich, Lin, Smith & Sharma, 1986). But two research programs have developed assessment instruments that can be useful for general program planning and evaluation (Pintrich & Johnson, 1990). Both of the two research programs are based on general cognitive models of information processing (See Figure 1). Figure 2 demonstrates the simple framework of how students learn, remember, and understand. First of all, students must be able to select the key points and the important information from lectures, discussions, and course reading. Secondly, students must be able to integrate and connect the new information to their previous knowledge in order to understand the new information.
Finally, students must be able to remember and apply the new information in new situations which become their experience (Pintrich & Johnson, 1990).

Weinstein and her colleagues (Weinstein, Schulte, & Palmer, 1987) developed *The Learning and Study Strategies Inventory* (LASSI) as part of the Cognitive Learning Strategies Project at the University of Texas at Austin (Weinstein, 1988). A team of researchers, leaded by Pintrich, developed *The Motivation Strategies for Learning Questionnaire* (MSLQ) at the Program on Learning and Teaching at the federally funded National Center for Research to Improve Postsecondary Teaching and Learning at the University of Michigan (Pintrich & Johnson, 1990; Pintrich, Smith, Garcia & McKeachie, 1991; Garcia & Pintrich, 1995).

![Simple cognitive model of information processing](image)

*Figure 1. Simple cognitive model of information processing (Adapted from Pintrich & Johnson, 1990)*
The Learning and Study Strategies Inventory (LASSI). The LASSI is a self-report questionnaire with ten scales and seventy-seven items. It takes twenty minutes to administer and can be self-scored by the students for immediate feedback. There are ten scales in the LASSI. They are divided into three components, which are motivation, self-management, and cognitive. Reflecting the traditional definitions of motivation, the motivation component includes three scales, which are attitude, motivation, and anxiety. The self-management component, consisting of the scheduling scale and concentration scale, reflects students' skills at directing and controlling their study behavior. The cognitive component includes information processing, selecting main ideas, study aids, self-testing, and test strategies scales. The cognitive component is based on the general information-processing idea that the more students actively connect and integrate the new information with their previous knowledge, the more they will understand and learn the material (Table 6) (Pintrich & Johnson, 1990). The validity and reliability data are very good for a self-report instrument, and there are norms available for the different scales to assist in interpretation (Weinstein, Zimmerman, & Palmer, 1988).

The Motivation Strategies for Learning Questionnaire (MSLQ). The MSLQ, like LASSI, is a self-report questionnaire. It takes about twenty to thirty minutes to administer (Pintrich, Smith, Garcia & McKeachie, 1991). The MSLQ has two main sections: one on motivation and one on learning strategies. The motivation section includes three general components (value, expectancy, and affect) and six scales (intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, self-efficacy for learning and performance, and test anxiety). The learning strategies section consists of two components
Table 6
Scales and Components of the LASSI and Reliabilities

<table>
<thead>
<tr>
<th>Scales and components</th>
<th>No. of items</th>
<th>Reliabilities (Alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motivation component</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Attitude scale</td>
<td>4</td>
<td>.60</td>
</tr>
<tr>
<td>2. Motivation scale</td>
<td>14</td>
<td>.87</td>
</tr>
<tr>
<td>3. Anxiety scale</td>
<td>10</td>
<td>.82</td>
</tr>
<tr>
<td><strong>Self-management component</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Scheduling</td>
<td>5</td>
<td>.69</td>
</tr>
<tr>
<td>5. Concentration</td>
<td>8</td>
<td>.82</td>
</tr>
<tr>
<td><strong>Cognitive component</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Information-processing</td>
<td>17</td>
<td>.88</td>
</tr>
<tr>
<td>7. Selecting main ideas</td>
<td>4</td>
<td>.61</td>
</tr>
<tr>
<td>8. Study aids</td>
<td>8</td>
<td>.69</td>
</tr>
<tr>
<td>9. Self-testing</td>
<td>5</td>
<td>.64</td>
</tr>
<tr>
<td>10. Test strategies</td>
<td>13</td>
<td>.83</td>
</tr>
</tbody>
</table>

*Adapted from Weinstein, Zimmerman, & Palmer, 1988.

(cognitive and metacognitive strategies, and resource management strategies) and eight scales (rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment, effort regulation, and help seeking) (Table 7) (Pintrich, Smith, Garcia & McKeachie, 1991). Even though the MSLQ has not been under development as long as the LASSI, the reliability and validity data appear to be adequate (Garcia & Pintrich, 1995).

**Differences between the LASSI and the MSLQ.** The MSLQ is based on the same general information-processing model as the LASSI. However, there are several differences between the LASSI and MSLQ as follows (Pintrich & Johnson, 1990):

1. Based on the traditional definitions of motivation, the motivation scales of the LASSI deal with students' attitude towards college, students' willingness to accept responsibility for the school work, and how much students worry about exams. On the other hand, the
motivation scales of MSLQ reflect a general social-cognitive approach to motivation processes involved in self-regulated learning. The social-cognitive approach perceives self-efficacy or beliefs concerning one's capabilities to organize and implement actions necessary to attain designed performance levels (Schunk, 1989). Thus, the motivation scales of MSLQ deal with how students value their learning, how confident students expect to succeed, and how much they worry in testing situations (Pintrich & Johnson, 1990).

Table 7
Scales and Components of MSLQ and Reliabilities*

<table>
<thead>
<tr>
<th>Scales and components</th>
<th>No. of items</th>
<th>Reliability (Alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Motivation Scales</strong></td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Value component</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Intrinsic goal orientation</td>
<td>4</td>
<td>.74</td>
</tr>
<tr>
<td>2. Extrinsic goal orientation</td>
<td>4</td>
<td>.62</td>
</tr>
<tr>
<td>3. Task value</td>
<td>6</td>
<td>.90</td>
</tr>
<tr>
<td>Expectancy component</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Control of learning beliefs</td>
<td>4</td>
<td>.68</td>
</tr>
<tr>
<td>5. Self-efficacy for learning and performance</td>
<td>8</td>
<td>.93</td>
</tr>
<tr>
<td>Affective component</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Test anxiety</td>
<td>5</td>
<td>.80</td>
</tr>
<tr>
<td><strong>Learning Strategies scales</strong></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Cognitive and metacognitive strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Rehearsal</td>
<td>4</td>
<td>.69</td>
</tr>
<tr>
<td>8. Elaboration</td>
<td>6</td>
<td>.76</td>
</tr>
<tr>
<td>9. Organization</td>
<td>4</td>
<td>.64</td>
</tr>
<tr>
<td>10. Critical thinking</td>
<td>5</td>
<td>.80</td>
</tr>
<tr>
<td>11. Metacognitive self-regulation</td>
<td>12</td>
<td>.79</td>
</tr>
<tr>
<td>Resource management strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Time and study environment</td>
<td>8</td>
<td>.76</td>
</tr>
<tr>
<td>13. Effort regulation</td>
<td>4</td>
<td>.69</td>
</tr>
<tr>
<td>14. Peer learning</td>
<td>3</td>
<td>.76</td>
</tr>
<tr>
<td>15. Help seeking</td>
<td>4</td>
<td>.52</td>
</tr>
</tbody>
</table>

*Adapted from Pintrich et al., 1991
2. Instead of grouping the cognitive strategies into one component as the LASSI does, the MSLQ organizes its cognitive strategies into general cognitive strategies and metacognitive strategies (Pintrich & Johnson, 1990).

3. The LASSI uses a five-point Likert scale to rate various descriptions of learning strategies, ranging from “Not at all typical of me” to “very much typical of me.” Whereas the MSLQ uses a seven-point Likert scale, ranging from “not at all true of me” to “very true of me.”

4. The MSLQ contextualizes motivation and learning strategies by assessing them at the course level, but the LASSI does this at a general level (Garcia & Pintrich, 1995).

5. The LASSI provides norms; however, the MSLQ does not provide norms since the MSLQ is designed to be used at the course level. The MSLQ assumes that students’ responses to the questions might vary as a function of different courses, so that the same individual might report different levels of motivation or strategy use depending on the course (Pintrich, Smith, Garcia & McKeachie, 1991).

Learning strategies and patterns of learning

Miller (1997b) conducted the only study related to learning strategies and published it in the *Journal of Agricultural Education* in the last 10 years. He identified 12 learning strategies used by students who were studying agriculture through videotapes. Pausing the tape while viewing and taking notes was the most used learning strategy by the students taking videotape courses.

Miller defined learning strategies as “the techniques or skills used by an individual in accomplishing a learning task” (Miller, 1997b, p. 21), a different definition from the one
previously cited in this literature review. Learning strategies was defined by Mayer (1988, p. 11) as “behaviors of a learner that are intended to manipulate a person’s cognitive processes during learning,” a definition which is much broader than the definition in Miller’s study. Instead of focusing on specific study skills or patterns for a particular type of courses, the previous literature review on learning strategies emphasized general study behaviors in the cognitive processes, such as rehearsal, elaboration, organization, comprehension, metacognition, and resource management (Cross & Steadman, 1996).

In their study on relationships between learning strategies and learning styles in a hypermedia environment, Liu and Reed (1994) used the term “patterns of learning” in discussing learning strategies. In Lui and Reed’s study, patterns of learning were measured by identifying how often the students accessed different functions in a hypermedia environment and how long students used the courseware, a process which seems to be quite similar to Miller’s (1997b) measurement of learning strategies. Liu and Reed (1994) found that participants with different learning styles used different patterns of learning in completing the same task.

Several studies were also found related to patterns of learning beyond agricultural education (Hartman, 1991; Kasworm & Blowers, 1994; Linstone & Hollingsworth, 1992; Shatz & Ebeling, 1991; Small & Ferreira, 1994). All these studies examined the frequencies of learning or teaching behavior in different learning settings with the intent to identify the patterns of learning. For example, Hartman (1991) examined the effect of computer network technologies on teacher-student and student-student interactions. He found that teachers in networked sections interacted more with their students than did teachers in regular sections:
also, they communicated more electronically with less able students than with more able students.

**Research studies related to learning strategies**

There were a number of studies related to learning strategies in the field of formal education. For example, Weinstein (1988) encouraged her students to take control of their own learning through learning strategies in a semester-long course on learning at the University of Texas at Austin. Evaluation showed self-reported gains in students' use of learning strategies, increased scores on the reading comprehension instrument, self-reported lower levels of anxiety, and improvement in other performance measures such as course assignment grades (Weinstein, 1988; Weinstein & Underwood, 1985). Weinstein and Underwood (1985) suggested that learning strategies and metacognition could be improved through instruction. Furthermore, Steadman (Cross & Steadman, 1996) administered the MSLQ as a pre- and posttest to several classes of community college students in an effort to measure change in students' use of learning strategies. She found the MSLQ was useful for compiling a picture of the types of strategies used and not used by students in each class, although it was difficult to show statistically significant gains in learning strategy use with a small group. In addition, Pintrich and Groot (1990) examined relationships among motivational orientation, self-regulated learning and classroom academic performance by using the MSLQ. Regression analyses revealed that, depending on the outcome measure, self-regulation, self-efficacy, and test anxiety emerged as the best predictors of performance. Furthermore, Birenbaum (1997) used the MSLQ to evaluate students' learning strategies and assessed the relationship between learning strategies and assessment preferences. He found
that use of learning strategies affected students’ assessment preferences and performances on different assessment types and thus caused bias in interpretation of assessment scores. It was recommended that students should have the freedom to choose their preferred assessment type from among the various forms of assessment.

**Motivation**

Motivation is a learning strategy component in both Weinstein’s and Pintrich’s instruments, LASSI and MSLQ (Pintrich, Smith, Garcia & McKeachie, 1991; Weinstein, Zimmerman, & Palmer, 1988). This corresponds to Bandura’s (1986) social cognitive theory, which postulates that motivational learning is motivation to acquire skills and strategies rather than perform tasks (Pintrich & Schunk, 1996). Bandura (1986) believed that motivation is goal-directed behavior initiated and sustained by expectations. However, McMillan and Forsyth (1991) argued that expectations and needs were the two crucial categories of factors that determine motivation. In addition, Ford (1992) proposed a motivational systems theory, that would describe in a comprehensive from the motivation of human behavior.

The next section of the literature review is a discussion of Ford’s motivational systems theory (1992), McMillan and Forsyth’s (1991) heuristic model of students’ motivation, Bandura’s view of motivation in social cognitive theory (1986), and research studies related to motivation.
Ford’s motivational systems theory

Attempting to organize the various motivational constructs from different theories into one model, Ford (1992) presented a comprehensive theory of human functioning and development, motivational systems theory (MST). The formula of MST for effective person-context functioning is (Ford, 1992; Pintrich & Schunk, 1996):

\[
\text{Achievement/Competence} = \frac{(\text{Motivation} \times \text{Skill})}{\text{Biology} \times \text{Responsive Environment}}
\]

This formula proposes that actual “achievement and competence are the result of a motivated, skillful, and biologically capable person interacting with a responsive environment” (Ford, 1992, p. 70). According to Ford (Pintrich & Schunk, 1996), in this formula,

...skill represents the various cognitive and information-processing functions as well as the actual behaviors necessary for...competent action. Biology is defined in terms of the person’s physical and biological capabilities that can enhance or constrain performance. Responsive environment includes the various contexts (home, school, community, etc.) that individuals move through that must provide positive opportunities for development. (p. 219)

In this theory, motivation provides the energy and direction for action (expectations or future-oriented function) as well as the evaluation of action in terms of whether to continue or stop (Pintrich & Schunk, 1996). Three main components are included in motivation as follows (Ford, 1992):

\[
\text{Motivation} = \text{Goals} \times \text{Emotions} \times \text{Personal agency beliefs}
\]

This model of motivation assumes that goals, emotions, and personal agency beliefs interact to determine motivation. The mathematical formula with multiplicative terms also means that if any of these three components are missing, then people will not be motivated in that
situation. Personal agency beliefs are basically the same construct as self-efficacy and control beliefs. Emotions are the various affects that are generated through interactions with the environment and provide evaluative information so as to regulate behavior. And goals are the directions and guidance for behavior (Pintrich & Schunk, 1996).

**A heuristic model of students’ motivation**

A heuristic model of college students’ motivation, developed by McMillan and Forsyth (1991), included the most important influences of motivation for learning (Figure 2). The model is based on the conditions that academic learning is primarily a cognitive activity and that students’ motivation is heavily influenced by their thinking about what they perceive as important and what they believe they can accomplish. Two crucial categories of factors are included in this model: needs and expectations.

Needs are inclined to motivate students to behave in order for them to gain satisfaction and rewards. Several well-established theories highlight different kinds of needs. Those needs that are considered to be the most relevant to college students’ learning are included in this model. They are self-actualization, need to achieve, competence, self-worth, developmental level, and goals. The term self-actualization is used to describe the human need that some students constantly strive toward to maximize their potential and pursue their goal to be as competent, creative, and effective as possible. Some students also develop a strong need to achieve success and are motivated by a sense of accomplishment and pride in achievement, not by rewards. Moreover, a primary need motivation for most college students is to become competent. This is a need to achieve mastery and accomplishment and to feel a sense of control. However, achievement situations require that
individuals maintain a positive view of themselves. Self-worth needs not only affect the choice to be involved in achievement situations but also the subsequent motivation. In addition, students are motivated by what interests them, what challenges them, and what competencies they would like to improve. Understanding the student development level helps educators find ways to motivate their students. Finally, students' needs are always determined by their goals. It is important to select educational goals and objectives that are worthy of learning (McMillan & Forsyth, 1991).

Figure 2. A heuristic model of college students' motivation (McMillan & Forsyth, 1991, p. 41).
The other category of motivation in McMillan and Forsyth’s model is expectation. The factors included in the expectation category of motivation are: self-efficacy, previous experience, success of others, feedback, and attributions. First of all, many motivation theorists believe that students with high self-efficacy have high expectations and are more likely to be involved in learning activities. Students need to realize that they have increased their competence through their own efforts. McMillan and Forsyth (1991) believed that students are guided most by how they see themselves, not by other objective evidence. Moreover, students who have previously had successful experiences tended to have high expectations of achievement whereas experiences of failure in the past produced negative expectations. Expectations can also be influenced greatly by feedback from teachers. Teachers’ expectations can influence students’ expectations, and feedback is a primary means of communicating teachers’ expectations. However, self-evaluations and expectations are influenced by comparison with peers, especially when objective standards of performance are missing. Finally, arbitration theory focuses on the explanations and justifications for success and failure. This theory suggests that beliefs about causes of success and failure affect emotional reactions, which in turn affect expectations and behaviors (McMillan & Forsyth, 1991).

Motivation in the social cognitive theory

Unlike other theories that consider motivation to be a performance variable, the social cognitive theory emphasizes that motivational processes influence both learning and performance. Bandura (1986) expanded social cognitive theory’s scope and integrated motivational processes with learning and self-regulation. Self-regulated learning is a
description of how and why students choose to use a particular self-regulated process, strategy, or response. Students can be described as self-regulated to the degree that they are metacognitively, motivationally, and behaviorally active participants in their own learning process (Zimmerman, 1989).

In the social cognitive theory, motivation is goal-directed behavior initiated and maintained by expectations and self-efficacy. Self-efficacy refers to "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1986, p. 391). Bandura (1986) postulated that self-efficacy influences choice of activities, effort, and persistence. Schunk (Pintrich & Schunk, 1996) developed a model of motivated learning that stresses the role of self-efficacy (Figure 3). This model hypothesizes that:

...at the start of the learning activity, students differ in their self-efficacy for learning, which depends on personal aptitudes and prior experiences. While working on the task, students are affected by task engagement variables that make salient cues that signal to students how well they are doing and cues that students use to appraise efficacy for continued learning. The perception of progress, along with higher efficacy, enhances motivation and skill acquisition. (Pintrich & Schunk, 1996, p. 177)

Research studies related to motivation

Six research studies related to motivation were found in the *Journal of Agricultural Education* in the year 1991 to 1997. Among the six studies, two studies (Bowen & Radhakrishna, 1991; Mwangi & McCaslin, 1994) examined the relationship between job satisfaction and motivation; one study (Culp, 1997) determined the motivation of 4-H volunteer leaders; and the other three studies were related to the participant's motivation to
Student Characteristics
Aptitudes
Prior experiences

Self-efficacy for learning

Task engagement variables
- Purpose of instruction
- Content difficulty
- Information processing
- Strategy instruction
- Instructional presentation
- Performance feedback
- Models
- Goals
- Rewards
- Attributional feedback

Self-efficacy cues
- Performance outcomes
- Outcome patterns
- Attributions
- Model similarity
- Persuader credibility
- Bodily symptoms

Figure 3. Model of motivational learning (Pintrich & Schunk, 1996, p. 178)
be involved in educational programs/courses. None of these studies focused on learning factors that motivated students to learn course content.

For example, Bowen and Radhakrishna (1991) investigated job satisfaction of agricultural education faculty by using Herzberg's motivation-hygiene theory. Mwangi and McCaslin (1994) identified eight job satisfaction factors related to motivation in a case study design using a group-administrated, closed-ended questionnaire with 105 job satisfaction and 10 motivation items. Culp (1997) determined the motivation of current and former adult volunteer 4-H leaders and found that their positive and negative motivations were similar. Using the Education Participation Scale, Miller (1992) found that cognitive interest was the highest motivation in his study of participation motivation in off-campus agricultural credit programs. Miller (1995a) identified the factors that motivated students to enroll in the off-campus agriculture program and found career advancement to be the highest rated factor. Based on McClelland's motivational needs theory, Turner and Herren (1997) examined the motivational needs of students enrolled in high school agricultural classes in Georgia. They found that agricultural students were motivated by the need for achievement and that FFA members had a greater need for achievement, affiliation, and power than non FFA members.

**Relationships Among Learning Styles, Learning Strategies, Motivation, and Student Achievement**

Learning styles, learning strategies, motivation, and student achievement were four concepts included in Curry's (1990) learning style taxonomy and contributions of learning style to learning outcomes (Figure 4). To provide an overview of the relationships among
Figure 4. Curry’s learning style taxonomy and contributions of learning styles to learning outcomes (Developed by Curry, 1990, p.13)
these concepts, this section examines Curry's taxonomy and discusses the research studies related to these concepts.

Curry's taxonomy

As shown in Figure 4, Curry (1990) hypothesized that the fundamental influence of preferences for environmental conditions and preferences for social conditions affect the maintenance of motivation. The motivation then affects the task engagement of the learner. The preferred cognitive information process will in turn take place initially as long as the learners engage themselves in the task. Based on Curry's (1990) illustration:

The central idea behind the taxonomy is that learner success in any "teaching-learning situation" requires positive motivation on the part of the student. Such motivation will lead to a sufficient degree of engagement in the task and to active task processing that will integrate the new information into long-term memory. (p. 1)

Learning style is conceived as a combination of one's motivation, engagement, and cognitive processing habits. Maintenance of motivation, level of engagement, and cognitive processing then connect to influence the use of metacognitive skills such as situation analysis, self-pacing, and self-evaluation. The specific knowledge and skills learned produce a learning outcome (Curry, 1990).

Metacognitive skills are one of the learning strategy components (Weinstein & Meyer, 1991; Cross & Steadman, 1996). Even though two learning strategy instruments, LASSI and MSLQ might have different definitions of motivation (Pintrich & Johnson, 1990), it is a component in both of them (Pintrich, Smith, Garcia & McKeachie, 1991; Weinstein, Zimmerman, & Palmer, 1988). Curry's taxonomy (1990) and the learning strategy concepts
seem to suggest that motivation, learning style, learning strategies, and student learning outcome were associated with each other.

**Studies related to these concepts**

Oxford, Park-Oh, Ito, and Sumrall (1993a; 1993b) conducted two studies to find the factors that influence student achievement in Japanese through the medium of satellite television and effects of the factors on students' achievement (Oxford, Park-Oh, Ito, & Sumrall, 1993a; 1993b). Results showed that motivation was the best predictor of Japanese language achievement, but the use of language learning strategies was also highly influential. Gender and learning style played potentially important roles, although previous language learning and course level were not especially explanatory (Oxford et al., 1993a; 1993b).

**Summary**

The purpose of this study was to evaluate how students with different styles learned and to identify factors influencing their learning in Web-based courses. A review of literature related to this study revealed that learning style consisted of the relatively stable psychological characteristics at the personality level that influence the way learners perceive, organize, and react to different situations. In the field of Agricultural Education, the Group Embedded Figures Test (GEFT) was the most commonly used learning style standardized instrument to access learning style. General learning strategies include rehearsal, elaboration, organization, comprehension, metacognition, and resource management. The learning strategy literature is based on the assumption that students’ motivation and use of learning strategies can be controlled by learners and changed through teaching. Two instruments,
LASSI and MSLQ, were developed to assess students' learning strategies. Motivation is goal-directed behavior instigated and sustained by expectations and self-efficacy to achieve the outcomes. Moreover, an attitude is an individual's tendency to answer favorably or unfavorably to a situation (Thompson, Higgins, & Howell, 1994). The literature supported the theory that attitudes, motivation, learning styles, learning strategies, and patterns of learning, are associated with student achievement.
CHAPTER III. METHODOLOGY

Introduction

The purpose of this descriptive/associational study was to evaluate how students with different learning styles learned and to identify factors influencing their achievement in Web-based courses. Objectives of the study were to identify:

a) demographic characteristics of the students in relation to their learning styles,

b) how attitudes, motivation, learning strategies, patterns of learning, and achievement differed in relation to students' learning styles,

c) relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning, achievement, and demographics, and

d) prediction of higher or lower achieving students based on attitudes, motivation, learning styles, learning strategies, patterns of learning, and demographics.

This chapter contains the following sections: population and sample for this study, instruments, pilot test, data collections, data analysis, limitations, assumptions, and summary.

Population and Sample for this Study

The study focused on the Web-based version of two non-major introductory courses taken by agricultural students, Zoology 155 and Biology 109. More than 60% (60) of the population were on-campus students, and almost 40% (39) were off-campus students. Thirty-two out of the 39 off-campus students were high school students.
Seventy-four (75%) students who completed the learning style test (GEFT), on-line questionnaire, and the Web-based courses (either Zoology 155 or Biology 109) by the end of the semester were considered to be the responding sample of this study.

Instrumentation

The Group Embedded Figures Test (GEFT), a purchased commercial test, was used to determine preferred learning style, either field-dependent (FD) or field independent (FI). Individuals scoring (12 or above) greater than the national mean (11.4) were classified as field-independent learners, whereas those scoring less than the national mean (11 or below) were considered to prefer a field-dependent style. The total possible raw score on the GEFT is 18. The reliability coefficient for the GEFT is .82 (Witkin, Oltman, Raskin, & Karp. 1971).

An on-line questionnaire was designed by the researcher and included four scales (motivation, learning strategies, patterns of learning, and attitude scales) plus demographic questions and an open-ended question. Eleven statements representing the attitude scale were modifications of the attitude scale used in Miller's study (1995b) on assessing attitudes of professional agricultural degree program graduates toward videotaped instruction. The Likert-type scale had these response options: 1 = Strongly Disagree, 2 = Disagree, 3 = Undecided, 4 = Agree, and 5 = Strongly Agree. Nine statements representing the motivation scale and thirteen statements representing the learning strategies scale were selected from the Motivation Strategies for Learning Questionnaire (MSLQ) (Pintrich, Smith, Garcia, & McKeachie. 1991). The students were asked to rate themselves according to how well the statements described them while they were taking the Web-based course. The 5-point scale
had the following response options: 1 = Not at all typical of me, 2 = Not very typical of me, 3 = Somewhat typical of me, 4 = Quite typical of me, and 5 = Very much typical of me.

Another aspect of learning strategies consists of patterns that students use to accomplish a task as they manipulate the techniques or interactive functions in the Web-based courses. Fifteen statements representing the patterns of learning scale were developed by the researcher. Response options for the 5-point scale were: 1 = None of the time, 2 = Part of the time, 3 = Some of the time, 4 = Most of the time, and 5 = All of the time. Demographic variables included types of students as off-campus, on-campus, or adult students, number of courses taken previously in the subject area, study and work hours per week, limited or unlimited access to a computer, class level, and gender. The open-ended question asked students to write down the reasons they took the Web-based courses.

Pilot Test

Content and face validity for the questionnaire were established by a panel of three faculty members associated with Project BIO and three graduate students in Agricultural Education. The scales were pilot-tested for reliability with a group of students taking an advanced undergraduate Project BIO Web-based course, Biology 201. Thirty-eight (95%) out of 40 students answered the questionnaire. Reliabilities of the four scales for the pilot test and for the study are displayed in Table 8. Cronbach's alpha was used to assess the reliability of the four scales. Cronbach's alpha coefficients for the pilot test were .91 .71 .80. and .72 for the attitude scale, motivation scale, learning strategy scale, and patterns of learning scale, respectively. When a post-hoc reliability analysis was performed, the
Table 8
Reliability Coefficients for Attitudes, Motivation, Learning Strategies, and Patterns of Learning Scales

<table>
<thead>
<tr>
<th>Scales</th>
<th>Pilot test</th>
<th>Post-hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitudes</td>
<td>.91</td>
<td>.85</td>
</tr>
<tr>
<td>Motivation</td>
<td>.71</td>
<td>.70</td>
</tr>
<tr>
<td>Learning strategies</td>
<td>.80</td>
<td>.79</td>
</tr>
<tr>
<td>Patterns of learning</td>
<td>.72</td>
<td>.70</td>
</tr>
</tbody>
</table>

\( n = 38 \)  
\( n = 74 \)

reliabilities for the four scales were .85, .70, .79, and .70 respectively. These reliabilities were considered acceptable according to Fraenkel & Wallen (1996).

Data Collection

The data collection process for this study was approved by the Committee on the Use of Human Subjects in Research at Iowa State University (Appendix A). Before the learning style test and on-line questionnaire were administered or posted on the web, a letter was sent to the high school administrators to seek permission for their students to participate in this study. The researchers administered the learning style test (GEFT) to on-campus students, and proctors administered it to off-campus students. Proctors read the instructions and watched the time while students were taking the GEFT. Several individual follow-up electronic letters were sent and phone calls were made to encourage the completion of the GEFT. A total of 79 (80%) students completed the GEFT. To control the nonresponse error, a final deadline was set for the students to complete the GEFT. Among the students who
twelve (16%) after the deadline. An on-line questionnaire, written in HTML (HyperText Markup Language) format, was posted three weeks before the final exams under ClassNet, which is a WWW server software designated to manage Internet class activities (ClassNet Overview, 1998). A follow-up electronic letter to nonrespondents of the on-line questionnaire yielded a total of 94 respondents for a 95% return rate. Instructors provided grades for all students at the end of the semester, and these were used as a measure of achievement.

For purposes of analysis, the GEFT scores, questionnaire responses, and students’ grades were matched. This yielded a final response rate of 74 (75%), which was considered to be an acceptable representation of the population. Nonresponse error was then controlled using responses from those students who completed the GEFT after the deadline. The matching process resulted in sixty-two (84%) who were considered to be respondents and 12 (16%) who were considered to be nonrespondents (Miller & Smith, 1983). A t-test was used to determine if respondents and nonrespondents differed significantly in their attitudes, motivation, use of learning strategies, patterns of learning, and learning styles. No significant (p<.05) difference was found between respondents and nonrespondents on motivation, use of learning strategies, patterns of learning, and student achievement. However, it was found that the attitude scores and GEFT scores of respondents were significantly different from nonrespondents. Results show that the GEFT scores of nonrespondents (mean = 15.58) were significantly higher than the respondents (mean = 12.10). And the attitude scores of nonrespondents (mean = 3.79) were also significantly higher than the respondents (mean = 3.38). This means that nonrespondents were more likely to be field-independent and to have more positive attitudes toward the Web-based
instruction. The reader is cautioned that findings related to learning styles and student attitudes might not accurately represent the learning styles and attitudes of the population.

**Data Analysis**

The data collected from the participants were coded, entered, and analyzed at the Graduate Student Office of the Department of Agricultural Education and Studies at Iowa State University. Data were analyzed using the Statistical Package for Social Science. Personal Computer Version (SPSSx/PC). Analyses of data included frequencies, means, standard deviations, t-tests, Pearson correlations, multiple linear regressions, and discriminant analysis. The alpha level was established *a priori* at the .05 level, meaning that the researcher was willing to accept a five percent chance of rejecting a null hypothesis that was actually true (Fraenkel & Wallen. 1996).

**Limitations**

1. This study was limited to future students in non-major introductory Web-based courses in biological sciences.
2. This study may not be generalizable to other types of courses.

**Assumptions**

1. That all students involved in this study answered truthfully questions related to motivation, learning strategies, patterns of learning, and attitudes toward their Web-based learning.
2. That learning styles are measurable and that learning style remains relatively constant for an individual.

3. That students completed the Group Embedded Figures Test (GEFT) diligently and to the best of their ability.

4. That homogeneity exists among the students of the two non-major introductory Biology and Zoology courses in this study.

Summary

This was a population study that included 99 students taking two non-major introductory Web-based courses, Zoology 155 and Biology 109, at Iowa State University. Seventy-four (75%) students who completed a learning style test (GEFT), an on-line questionnaire, and the Web-based courses by the end of the semester were considered to be an acceptable representation of the population. The Group Embedded Figures Test (GEFT) was used to determine preferred learning styles, either as field-dependent (FD) or field-independent (FI). The on-line questionnaire consisted of four scales (motivation, learning strategies, patterns of learning, and attitude) and demographic questions about numbers of courses taken previously in the subject area, study and work hours per week, class level, and gender, and an open-ended question about reasons students took the Web-based courses. Cronbach’s alpha was used to assess the reliability of the four scales, and alpha coefficients ranged from .71 to .91. The questionnaire, written in HTML format, was posted on the Web. Learning style scores, questionnaire responses, and student grades were matched yielding a final response rate of 74 (75%). Nonresponse error was then controlled using responses from those students who completed the GEFT after the deadline for taking it. Analyses of data
included frequencies, means, standard deviations, t-tests, Pearson correlations, multiple linear
regressions, and discriminant regression. The alpha level was established *a priori* at the .05
level.
CHAPTER IV. FINDINGS

Introduction

The purpose of this study was to evaluate how students with different learning styles learned and to identify factors influencing their achievement in Web-based courses. Objectives of the study were to identify:

a) demographic characteristics of the students in relation to their learning styles,

b) how attitudes, motivation, learning strategies, patterns of learning, and achievement differed in relation to students' learning styles,

c) relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning, achievement, and demographics, and

d) prediction of higher or lower achieving students based on attitudes, motivation, learning styles, learning strategies, patterns of learning, and demographics.

The data were organized under the following headings: (a) demographic data by learning style, (b) differences in attitudes, motivation, learning strategies, patterns of learning, and achievement by learning style, (c) relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning, achievement, and demographics, (d) prediction of higher or lower achieving students based on attitudes, motivation, learning strategies, patterns of learning, learning styles, and demographics, and (e) summary.
Demographic Data by Learning Styles

Frequencies of demographic data by learning styles

Table 9 displays frequencies and percentages of demographic data of the respondents by learning styles. The usable responses included 29 (39%) in the zoology class and 45 (61%) in the biology class. Less than half (29; 39%) of the usable respondents were males. Twenty-eight (38%) were high school students and forty-six (62%) were university students. Forty-one (55%) were on-campus students; twenty-eight (37%) were off-campus students; and five (8%) were adult students. Although these were introductory, non-major, freshman level courses, 44% of the students were juniors or seniors in college. Forty-five (61%) students had unlimited access to a computer; whereas twenty-nine students could only access a computer at a set time. More than two thirds (51; 69%) of the respondents were field-independent learners. On average, the students had previously taken 1.45 courses in the subject area of zoology or biology (Table 10). The students spent an average of 3.27 hours per week studying, ranging from 1 to 20 hours, and worked an average of 16.97 hours per week, ranging from 0 to 80 hours.

Tests for differences by learning styles

No significant differences by learning styles were found in the number of courses taken previously, study hours per week, or work hours per week (Table 10).

Respondents' learning style scores were compared by gender (Table 11). It was found that the male learning style mean score (mean = 14.07) was significantly higher than the female mean score (mean = 11.76). The learning style mean score of all respondents was 12.66 with a standard deviation of 4.61.
Table 9
Description of Field-Dependent (FD) and Field-Independent (FI) Respondents by Class, Gender, Class Level, Student Type, and Access to Computer

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>n</th>
<th>%</th>
<th>Learning Style</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
<td>Zoology</td>
<td>29</td>
<td>39</td>
<td>11</td>
<td>38</td>
<td>18</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biology</td>
<td>45</td>
<td>61</td>
<td>12</td>
<td>27</td>
<td>33</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>29</td>
<td>39</td>
<td>4</td>
<td>14</td>
<td>25</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>45</td>
<td>61</td>
<td>19</td>
<td>42</td>
<td>26</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td>Class Level</td>
<td>High School</td>
<td>28</td>
<td>38</td>
<td>8</td>
<td>29</td>
<td>20</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td></td>
<td>University</td>
<td>46</td>
<td>62</td>
<td>15</td>
<td>33</td>
<td>31</td>
<td>67</td>
<td></td>
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<tr>
<td>Student Type</td>
<td>On-Campus</td>
<td>41</td>
<td>55</td>
<td>13</td>
<td>32</td>
<td>28</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Off-Campus</td>
<td>28</td>
<td>38</td>
<td>9</td>
<td>32</td>
<td>19</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adult Students</td>
<td>5</td>
<td>7</td>
<td>1</td>
<td>20</td>
<td>4</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>Access to Computers</td>
<td>Limited</td>
<td>29</td>
<td>39</td>
<td>9</td>
<td>31</td>
<td>20</td>
<td>69</td>
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<tr>
<td></td>
<td>Unlimited</td>
<td>45</td>
<td>61</td>
<td>14</td>
<td>31</td>
<td>31</td>
<td>69</td>
<td></td>
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<tr>
<td>Total</td>
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<td>100</td>
<td>23</td>
<td>31</td>
<td>51</td>
<td>69</td>
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</tbody>
</table>

Table 10
Description of Field-Dependent (FD) and Field-Independent (FI) Respondents by Selected Demographic Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>Learning Style</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean (SD)</td>
<td>n</td>
</tr>
<tr>
<td>Courses taken in the same subject area</td>
<td>74</td>
<td>1.45 (1.53)</td>
<td>23</td>
</tr>
<tr>
<td>Study hours/week for this course</td>
<td>74</td>
<td>4.55 (16.97)</td>
<td>23</td>
</tr>
<tr>
<td>Work hours/week for pay</td>
<td>74</td>
<td>16.97 (15.96)</td>
<td>23</td>
</tr>
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</table>
Table 11
Means, Standard Deviations, and t-test of Respondents’ Learning Style Scores By Gender

<table>
<thead>
<tr>
<th>Variable</th>
<th>Gender</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Male</td>
<td>Female</td>
<td></td>
<td></td>
</tr>
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<td>n</td>
<td>Mean (SD)</td>
<td>n Mean (SD)</td>
<td>n Mean (SD)</td>
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</tr>
<tr>
<td>Learning style scores</td>
<td>74</td>
<td>12.66 (4.61)</td>
<td>29 14.07 (4.57)</td>
<td>45 11.76 (4.46)</td>
<td>2.16*</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

Differences in Attitudes, Motivation, Learning Strategies, Patterns of Learning, and Achievement by Learning Styles

Attitudes by learning styles

Table 12 presents the means and standard deviations for individual statements by learning style for student attitudes toward Web-based instruction. No significant difference was found between field-dependent students (mean = 3.60) and field-independent students (mean = 3.37) in their attitudes toward Web-based instruction. Overall, the mean scores on the eleven attitude statements ranged from 2.62 to 4.03. Results showed that students provided the highest positive response for the statements related to the convenience of Web-based instruction (mean = 4.03). They also agreed with the ability to control the pace of learning (mean = 4.00), delivery of more Web-based instruction (mean = 3.69), recommendations of Web-based courses to friends (mean = 3.62), and opportunities for learning provided by Web-based courses (mean = 3.57). Student attitude was undecided, but close to agreeing that they enjoyed learning from Web-based instruction (mean = 3.49).
Table 12
Means, Standard Deviations, and t-test for Respondents' Attitudes by Field-Dependent (FD) or Field-Independent (FI) Learning Style (n = 74)

<table>
<thead>
<tr>
<th>Attitude Statements</th>
<th>Learning Style</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>FD</td>
<td>FI</td>
<td>t-value</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning through Web-based instruction is convenient</td>
<td>4.03 (1.11)</td>
<td>4.04 (.82)</td>
<td>3.98 (.97)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Web-based courses allow me to control the pace of my learning</td>
<td>4.00 (.92)</td>
<td>4.13 (1.25)</td>
<td>3.98 (1.05)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Web-based courses should be utilized more often to deliver instruction</td>
<td>3.69 (.89)</td>
<td>3.91 (.60)</td>
<td>3.59 (.98)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will recommend Web-based courses to my friends</td>
<td>3.62 (1.00)</td>
<td>3.78 (.95)</td>
<td>3.55 (1.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Web-based courses provide me with learning opportunities that I otherwise would not have had</td>
<td>3.57 (1.11)</td>
<td>3.61 (1.16)</td>
<td>3.55 (1.10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I enjoy learning from the Web-based lessons</td>
<td>3.49 (1.06)</td>
<td>3.83 (.83)</td>
<td>3.33 (1.13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will enroll in another Web-based course</td>
<td>3.27 (1.01)</td>
<td>3.30 (.88)</td>
<td>3.25 (1.07)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I feel isolated as a student when I take courses via the web^</td>
<td>3.01 (1.20)</td>
<td>2.91 (1.20)</td>
<td>3.06 (1.21)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would not have taken Web-based courses if I had some other means of acquiring course credits^</td>
<td>2.80 (.99)</td>
<td>2.61 (.89)</td>
<td>2.88 (1.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I prefer Web-based courses to traditional classroom instruction</td>
<td>2.65 (1.05)</td>
<td>2.87 (.87)</td>
<td>2.55 (1.12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning through Web-based courses is boring^</td>
<td>2.62 (1.02)</td>
<td>2.35 (1.07)</td>
<td>2.75 (1.00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3.49 (.64)</strong></td>
<td><strong>3.60 (.60)</strong></td>
<td><strong>3.37 (.68)</strong></td>
<td><strong>1.38</strong></td>
<td></td>
</tr>
</tbody>
</table>

Note: Scale 1=Strongly disagree, 2=Disagree, 3=Undecided, 4=Agree, and 5=Strongly Agree.
^Negatively stated items. Means of these statements were reversed in the total mean.
They were undecided about whether they preferred Web-based courses to traditional classroom instruction (mean = 2.65), and whether learning through Web-based courses was boring to them (mean = 2.62).

Motivation by learning style

Although field-independent students had a mean of 3.51 and field-dependent students had a mean of 3.42, there was no significant difference (at the .05 level) in student motivation by learning style.

Table 13
Means, Standard Deviations, and t-test for Respondents' Motivation by Field-Dependent (FD) or Field-Independent (FI) Learning Style (n = 74)

<table>
<thead>
<tr>
<th>Motivation Statements</th>
<th>Total</th>
<th>Learning Style</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Mean</td>
</tr>
<tr>
<td></td>
<td>(SD)</td>
<td>(SD)</td>
</tr>
<tr>
<td>I want to get better grades than other students</td>
<td>4.21</td>
<td>4.26</td>
</tr>
<tr>
<td></td>
<td>(1.01)</td>
<td>(.96)</td>
</tr>
<tr>
<td>I expect to do well in this class</td>
<td>3.77</td>
<td>3.78</td>
</tr>
<tr>
<td></td>
<td>(.84)</td>
<td>(1.00)</td>
</tr>
<tr>
<td>Studying appropriately. I can learn the material</td>
<td>3.70</td>
<td>3.43</td>
</tr>
<tr>
<td></td>
<td>(.89)</td>
<td>(.84)</td>
</tr>
<tr>
<td>I prefer course material that arouses my curiosity</td>
<td>3.66</td>
<td>3.48</td>
</tr>
<tr>
<td></td>
<td>(.80)</td>
<td>(.67)</td>
</tr>
<tr>
<td>I am satisfied with trying to understand content</td>
<td>3.49</td>
<td>3.48</td>
</tr>
<tr>
<td></td>
<td>(.80)</td>
<td>(.67)</td>
</tr>
<tr>
<td>Course material is useful to learn</td>
<td>3.49</td>
<td>3.52</td>
</tr>
<tr>
<td></td>
<td>(.83)</td>
<td>(.85)</td>
</tr>
<tr>
<td>I think of the questions I cannot answer\footnote{a}</td>
<td>3.30</td>
<td>3.30</td>
</tr>
<tr>
<td></td>
<td>(1.08)</td>
<td>(1.15)</td>
</tr>
<tr>
<td>I am interested in the content area of this course</td>
<td>3.14</td>
<td>3.00</td>
</tr>
<tr>
<td></td>
<td>(.93)</td>
<td>(.95)</td>
</tr>
<tr>
<td>I think of how poorly I am doing\footnote{a}</td>
<td>2.81</td>
<td>2.83</td>
</tr>
<tr>
<td></td>
<td>(1.51)</td>
<td>(1.67)</td>
</tr>
<tr>
<td>Total</td>
<td>3.48</td>
<td>3.43</td>
</tr>
<tr>
<td></td>
<td>(.52)</td>
<td>(.57)</td>
</tr>
</tbody>
</table>

Note: Scale 1=Not at all typical of me, 2=Not very typical of me, 3=Somewhat typical of me, 4=Quite typical of me, and 5=Very much typical of me.
\footnote{a}Negatively stated items. Means of these statements were reversed in the total mean.
motivation by learning style (Table 13). The mean scores on the nine statements ranged from 2.81 to 4.21. Four statements were rated above 3.50. The highest rated motivation was that the students wanted to get better grades than most other students (mean = 4.21). The second most highly rated item was that they expected to do well in the class (mean = 3.77). They also believed that they could do better if they studied in appropriate ways (mean = 3.70), and they preferred course material that aroused their curiosity (mean = 3.66). Only one statement, “I think of how poorly I am doing,” was rated below 3.00. The overall mean for student motivation in Web-based learning was 3.48 with a standard deviation of .52.

Learning strategies by learning styles

Field-dependent students (mean = 3.27) had almost the same mean on the learning strategy scale as did field-independent students (mean = 3.25), and no significant difference (.05 level) was found in the t-test when comparing their use of learning strategies (Table 14). Moreover, four of the thirteen learning strategy items were rated above 3.50. The highest-used learning strategy was to find the most important ideas from lectures (mean = 3.85). The second most highly used strategy was to memorize key words of important concepts (mean = 3.76). The third most highly used strategy was to relate new concepts to what they already knew (mean = 3.70). The next most highly used strategy was to determine the concepts they did not understand well (mean = 3.68). The two lowest used strategies had mean scores under 2.50. They were “to give up the difficult parts and study the easy ones” (mean = 2.16) and “make charts or tables to organize the material” (mean = 2.14). The overall mean score for students’ use of learning strategies was 3.25 with a standard deviation of .51.
Table 14
Means, Standard Deviations, and t-test for Respondents' Use of Learning Strategies by Field-Dependent (FD) or Field-Independent (FI) Learning Style (n = 74)

<table>
<thead>
<tr>
<th>Learning Strategy Statements</th>
<th>Total Mean (SD)</th>
<th>Field-Dependent Mean (SD)</th>
<th>Field-Independent Mean (SD)</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Try to find most important ideas from lectures</td>
<td>3.85 (.82)</td>
<td>3.87 (.92)</td>
<td>3.84 (.78)</td>
<td></td>
</tr>
<tr>
<td>Memorize key words of important concepts</td>
<td>3.76 (.86)</td>
<td>3.78 (.85)</td>
<td>3.75 (.87)</td>
<td></td>
</tr>
<tr>
<td>Try to relate to what I already know</td>
<td>3.70 (.92)</td>
<td>3.74 (.92)</td>
<td>3.69 (.93)</td>
<td></td>
</tr>
<tr>
<td>Determine concepts I don't understand well</td>
<td>3.68 (.85)</td>
<td>3.65 (.88)</td>
<td>3.69 (.84)</td>
<td></td>
</tr>
<tr>
<td>Connect the readings and concepts</td>
<td>3.47 (.88)</td>
<td>3.65 (.98)</td>
<td>3.39 (.83)</td>
<td></td>
</tr>
<tr>
<td>Read notes and readings over and over again</td>
<td>3.08 (1.12)</td>
<td>3.43 (1.20)</td>
<td>2.92 (1.06)</td>
<td></td>
</tr>
<tr>
<td>Relate my ideas to what I am learning</td>
<td>2.99 (1.04)</td>
<td>2.74 (1.08)</td>
<td>3.10 (1.08)</td>
<td></td>
</tr>
<tr>
<td>Decide what I am supposed to learn from topics</td>
<td>2.93 (.93)</td>
<td>2.96 (.93)</td>
<td>2.92 (.93)</td>
<td></td>
</tr>
<tr>
<td>Make good use of my study time</td>
<td>2.84 (.91)</td>
<td>2.87 (.93)</td>
<td>2.82 (.93)</td>
<td></td>
</tr>
<tr>
<td>Think of possible alternatives for conclusions</td>
<td>2.81 (.90)</td>
<td>2.61 (.93)</td>
<td>2.90 (.93)</td>
<td></td>
</tr>
<tr>
<td>Rarely find time to review notes or readings for tests*</td>
<td>2.79 (1.22)</td>
<td>2.65 (1.47)</td>
<td>2.86 (1.11)</td>
<td></td>
</tr>
<tr>
<td>Give up the difficult parts and study the easy ones*</td>
<td>2.16 (.76)</td>
<td>2.26 (.75)</td>
<td>2.11 (.77)</td>
<td></td>
</tr>
<tr>
<td>Make charts or tables to organize the material</td>
<td>2.14 (1.10)</td>
<td>2.09 (1.20)</td>
<td>2.16 (1.07)</td>
<td></td>
</tr>
<tr>
<td><strong>Total Mean</strong></td>
<td><strong>3.25 (.51)</strong></td>
<td><strong>3.27 (.64)</strong></td>
<td><strong>3.25 (.45)</strong></td>
<td><strong>.17</strong></td>
</tr>
</tbody>
</table>

Note: Scale 1=Not at all typical of me, 2=Not very typical of me, 3=Somewhat typical of me, 4=Quite typical of me, and 5=Very much typical of me.

\*Negatively stated items. Means of these statements were reversed in the total mean.
Patterns of learning by learning styles

Table 15 presents the means and standard deviations for individual items by learning style on the patterns of learning scale. The field-dependent students had a mean of 3.00 for the total patterns of learning scale and field-independent students had a mean of 2.88, and no significant difference (.05 level) was found. Six patterns of learning were rated above the mean score of 3.50. They were: check scores of the tests or assignments (mean = 4.54), view the slides (mean = 4.19), listen to the audio of the lessons (mean = 3.95), check the answers of the tests or assignments (mean = 3.93), read course handout package (3.70), and take notes while listening to the audio of the lessons (mean = 3.58). Seven patterns of learning were rated below the mean score of 2.50. They were: view the slides more than once, interact with instructor, listen to the audio more than once (mean = 1.84), communicate with the class via e-mail (mean = 1.82), communicate with the class via discussion net forum (mean = 1.80), use the CD ROM disk accompanying the textbook (mean = 1.47), and communicate with the class via chat net forum (mean = 1.47). The overall mean for use of patterns of learning in Web-based courses was 2.88 with a standard deviation of .53.

Achievement by learning styles

To avoid the grading differences between Zoology 155 and Biology 109, student grades were transformed into standardized scores separately for each class. Standardized score is computed by subtracting the mean from the raw score and dividing the result by the standard deviation (Hinkle, Wiersma, & Jurs, 1994). Figure 5 presents the frequencies of the students' standardized scores. Table 16 shows that field-independent students' standardized achievement had a z-score mean of .06 and field-dependent students' z-score mean was -.14.
<table>
<thead>
<tr>
<th>Patterns of Learning Items</th>
<th>Learning Style</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>FD</td>
<td>FI</td>
<td>t-value</td>
<td></td>
</tr>
<tr>
<td>Check scores of the tests or assignments</td>
<td>4.54 (.96)</td>
<td>4.39 (1.23)</td>
<td>4.61 (.81)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>View the slides</td>
<td>4.19 (1.14)</td>
<td>4.32 (0.99)</td>
<td>4.14 (1.20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listen to the audio of the lessons</td>
<td>3.95 (1.35)</td>
<td>4.22 (1.31)</td>
<td>3.82 (1.19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check the answers of the tests or assignments</td>
<td>3.93 (1.26)</td>
<td>3.70 (1.52)</td>
<td>4.04 (1.12)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read course handout package</td>
<td>3.70 (1.66)</td>
<td>4.22 (1.38)</td>
<td>3.47 (1.74)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take notes while listening to the audio of the lessons</td>
<td>3.58 (1.52)</td>
<td>3.70 (1.69)</td>
<td>3.53 (1.45)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take notes while viewing slides</td>
<td>3.48 (1.62)</td>
<td>3.61 (1.67)</td>
<td>3.42 (1.60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read textbook</td>
<td>3.10 (1.40)</td>
<td>3.14 (1.31)</td>
<td>3.08 (1.44)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>View the slides more than once</td>
<td>2.35 (1.15)</td>
<td>2.43 (1.08)</td>
<td>2.31 (1.19)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interact with instructor</td>
<td>2.09 (.89)</td>
<td>2.22 (1.00)</td>
<td>2.04 (.85)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Listen to the audio more than once</td>
<td>1.84 (1.06)</td>
<td>2.00 (1.00)</td>
<td>1.76 (1.09)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communicate with the class via e-mail</td>
<td>1.82 (.82)</td>
<td>1.83 (.89)</td>
<td>1.82 (.79)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communicate with the class via discussion net forum</td>
<td>1.80 (.81)</td>
<td>1.83 (.89)</td>
<td>1.78 (.78)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use CD ROM (that came with the textbook)</td>
<td>1.47 (.95)</td>
<td>1.74 (1.25)</td>
<td>1.35 (.77)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communicate with the class via chat net forum</td>
<td>1.47 (.85)</td>
<td>1.65 (1.07)</td>
<td>1.39 (.72)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2.88</strong> (.53)</td>
<td><strong>3.00</strong> (.57)</td>
<td><strong>2.83</strong> (.51)</td>
<td><strong>1.26</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Scale 1=None of the time, 2=Part of the time, 3=Some of the time, 4=Most of the time, and 5=All of the time.*
Figure 5. Frequencies and percentages of respondents' standardized achievement scores (z-scores)

Table 16
Means, Standard Deviations, and t-tests of Respondents' Overall Standardized Achievement Scores by Learning Style

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>Field-Dependent</th>
<th>Field-Independent</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Mean (SD)</td>
<td>n</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Achievement³</td>
<td>74</td>
<td>.00 (1.00)</td>
<td>23</td>
<td>-.14 (1.00)</td>
</tr>
</tbody>
</table>

³z-score
Results of the t-tests showed that no significant difference was found on respondents' overall achievement score by learning style.

**Relationships Among Student Attitudes, Motivation, Learning Styles, Learning Strategies, Patterns of Learning, Achievement, and Demographics**

**Attitudes and achievement**

Table 17 shows the Pearson correlations between standardized achievement scores and attitudes. Eleven relationships were investigated that ranged in magnitude from negligible to low. Two associations were negligible and nine were low. None of the relationships were significant.

**Motivation and achievement**

Pearson correlations were used to describe associations between student achievement and motivation (Table 18). Twelve relationships were investigated that ranged from negligible to substantial. One association was negligible, five were low, five were moderate, and one was substantial. Seven of the relationships were significant. Results showed that higher achieving students were more likely to expect to do well in the class \((r = .52)\), to value the course material as useful to them \((r = .47)\), and to be interested in the content area of the course \((r = .31)\). Moreover, those students who tended to think how poorly they were doing were more likely to get poorer grades.
Table 17
Correlations Between Standardized Achievement Scores and Attitudes (n = 74)

<table>
<thead>
<tr>
<th>Attitude Statements</th>
<th>Correlations</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning through Web-based courses is boring</td>
<td>-.22</td>
<td>Low</td>
</tr>
<tr>
<td>I will enroll in another Web-based course</td>
<td>.21</td>
<td>Low</td>
</tr>
<tr>
<td>I prefer Web-based courses to traditional classroom instruction</td>
<td>.18</td>
<td>Low</td>
</tr>
<tr>
<td>Web-based courses allow me to control the pace of my learning</td>
<td>.18</td>
<td>Low</td>
</tr>
<tr>
<td>I will recommend Web-based courses to my friends</td>
<td>.17</td>
<td>Low</td>
</tr>
<tr>
<td>I would not have taken Web-based courses if I had some other means of acquiring course credits</td>
<td>-.15</td>
<td>Low</td>
</tr>
<tr>
<td>Web-based courses provide me with learning opportunities that I otherwise would not have had</td>
<td>.14</td>
<td>Low</td>
</tr>
<tr>
<td>Learning through Web-based instruction is convenient</td>
<td>.14</td>
<td>Low</td>
</tr>
<tr>
<td>I enjoy learning from the Web-based course</td>
<td>.13</td>
<td>Low</td>
</tr>
<tr>
<td>Web-based courses should be utilized more often to deliver instruction</td>
<td>-.01</td>
<td>Negligible</td>
</tr>
<tr>
<td>I feel isolated as a student when I take courses via the web</td>
<td>-.01</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

Table 18
Correlations Between Standardized Achievement Scores and Motivation (n = 74)

<table>
<thead>
<tr>
<th>Motivation Statements</th>
<th>Correlations</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>I expect to do well in this class.</td>
<td>.52*</td>
<td>Substantial</td>
</tr>
<tr>
<td>Course material is useful to learn</td>
<td>.47*</td>
<td>Moderate</td>
</tr>
<tr>
<td>I am interested in the content area of this course</td>
<td>.31*</td>
<td>Moderate</td>
</tr>
<tr>
<td>I think of how poorly I am doing</td>
<td>-.31*</td>
<td>Moderate</td>
</tr>
<tr>
<td>I want to get better grades than other students</td>
<td>.29*</td>
<td>Low</td>
</tr>
<tr>
<td>I am satisfied with trying to understand content</td>
<td>.27*</td>
<td>Low</td>
</tr>
<tr>
<td>Studying appropriately. I can learn the material</td>
<td>.27*</td>
<td>Low</td>
</tr>
<tr>
<td>I prefer course material that arouses my curiosity</td>
<td>.22</td>
<td>Low</td>
</tr>
<tr>
<td>I think of the questions I can not answer</td>
<td>-.03</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

*p < .05
Learning strategies and achievement

Table 19 shows the Pearson correlations between standardized achievement scores and learning strategies. Sixteen relationships were determined that ranged in magnitude from moderate to low. Half of the correlations were moderate and the other half were low. Eight of the relationships were significant. Results showed that higher achieving students were more likely to memorize key words of important concepts, connect the readings and concepts, decide what they were supposed to learn from topics, determine the concepts they did not understand well, and make good use of their study time. Those students who rarely found time to review notes or readings for tests were more likely to get poorer grades.

Patterns of learning and achievement

Pearson correlations were used to describe associations between student achievement and motivation (Table 20). Fifteen relationships were investigated that ranged in magnitude.

<table>
<thead>
<tr>
<th>Learning Strategy Statements</th>
<th>Correlations</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memorize key words of important concepts</td>
<td>.47*</td>
<td>Moderate</td>
</tr>
<tr>
<td>Connect the readings and concepts</td>
<td>.35*</td>
<td>Moderate</td>
</tr>
<tr>
<td>Rarely find time to review notes or readings for tests</td>
<td>-.31*</td>
<td>Moderate</td>
</tr>
<tr>
<td>Decide what I am supposed to learn from topics</td>
<td>.30*</td>
<td>Moderate</td>
</tr>
<tr>
<td>Determine concepts I don't understand well</td>
<td>.30*</td>
<td>Moderate</td>
</tr>
<tr>
<td>Read notes and readings over and over again</td>
<td>.29*</td>
<td>Low</td>
</tr>
<tr>
<td>Make good use of my study time</td>
<td>.27*</td>
<td>Low</td>
</tr>
<tr>
<td>Try to relate to what I already know</td>
<td>.23*</td>
<td>Low</td>
</tr>
<tr>
<td>Relate my ideas to what I am learning</td>
<td>.22</td>
<td>Low</td>
</tr>
<tr>
<td>Think of possible alternatives for conclusions</td>
<td>.22</td>
<td>Low</td>
</tr>
<tr>
<td>Give up the difficult parts and study the easy ones</td>
<td>-.21</td>
<td>Low</td>
</tr>
<tr>
<td>Try to find most important ideas from lectures</td>
<td>.18</td>
<td>Low</td>
</tr>
<tr>
<td>Make charts or tables to organize the material</td>
<td>.18</td>
<td>Low</td>
</tr>
</tbody>
</table>

* p < .05
from negligible to substantial. Seven associations were negligible and eight were low. Four of the relationships were significant. Results showed that higher achieving students were more likely to check the answers of the tests/assignments ($r = .28$), check the scores of the tests/assignments ($r = .26$), listen to the audio of the lessons ($r = .24$), and view the slides ($r = .21$).

**Regression**

A hierarchical regression analysis was conducted to ascertain the amount of variance in students' standardized achievement scores by the variable of interest. Table 21 presents the intercorrelations for the variables used in the regression. Twenty-six significant relationships were found. However, it was not necessary to consider the effect of the multicollinearity between the variables because no relationship was higher than .80 (Hinkle, Wiersma, & Jurs, 1994).

Table 20
Correlations Between Standardized Achievement Scores and Patterns of Learning ($n = 74$)

<table>
<thead>
<tr>
<th>Patterns of Learning Statements</th>
<th>Correlations</th>
<th>Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the answers of the tests/assignments</td>
<td>.28*</td>
<td>Low</td>
</tr>
<tr>
<td>Check the scores of the tests/assignments</td>
<td>.26*</td>
<td>Low</td>
</tr>
<tr>
<td>Listen to the audio of the lessons</td>
<td>.24*</td>
<td>Low</td>
</tr>
<tr>
<td>View the slides</td>
<td>.21*</td>
<td>Low</td>
</tr>
<tr>
<td>Communicate with the class via chat net forum</td>
<td>-.19</td>
<td>Low</td>
</tr>
<tr>
<td>Take notes while listening to the audio of the lessons</td>
<td>.13</td>
<td>Low</td>
</tr>
<tr>
<td>Listen to the audio more than once</td>
<td>.11</td>
<td>Low</td>
</tr>
<tr>
<td>Use CD ROM</td>
<td>-.11</td>
<td>Low</td>
</tr>
<tr>
<td>Read the textbook</td>
<td>.07</td>
<td>Negligible</td>
</tr>
<tr>
<td>View the slides more than once</td>
<td>.07</td>
<td>Negligible</td>
</tr>
<tr>
<td>Interact with instructor</td>
<td>-.06</td>
<td>Negligible</td>
</tr>
<tr>
<td>Communicate with the class via e-mail</td>
<td>.05</td>
<td>Negligible</td>
</tr>
<tr>
<td>Take notes while viewing slides</td>
<td>-.02</td>
<td>Negligible</td>
</tr>
<tr>
<td>Read course handout package</td>
<td>.02</td>
<td>Negligible</td>
</tr>
<tr>
<td>Communicate with the class via discussion net forum</td>
<td>.07</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

* $p < .05$
Table 21
Summary of Correlations Between Standardized Achievement Scores and Selected Variables
(n=74)

<table>
<thead>
<tr>
<th>Variable</th>
<th>X1</th>
<th>X2</th>
<th>X3</th>
<th>X4</th>
<th>X5</th>
<th>X6</th>
<th>X7</th>
<th>X8</th>
<th>X9</th>
<th>X10</th>
<th>X11</th>
<th>X12</th>
<th>X13</th>
<th>X14</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender* (X1)</td>
<td>1.00</td>
<td>.09</td>
<td>-.51*</td>
<td>-.50*</td>
<td>.51*</td>
<td>.02</td>
<td>.07</td>
<td>.08</td>
<td>-.17</td>
<td>-.07</td>
<td>.04</td>
<td>.04</td>
<td>.33*</td>
<td>-.25*</td>
<td>-.06</td>
</tr>
<tr>
<td>Class* (X2)</td>
<td>1.00</td>
<td>-.34*</td>
<td>-.39*</td>
<td>.34*</td>
<td>-.04</td>
<td>.07</td>
<td>.05</td>
<td>-.41*</td>
<td>.00</td>
<td>.01</td>
<td>.11</td>
<td>-.13</td>
<td>.09</td>
<td>.00</td>
<td></td>
</tr>
<tr>
<td>Class level* (X3)</td>
<td>1.00</td>
<td>.87*</td>
<td>-.94*</td>
<td>-.12</td>
<td>.12</td>
<td>.06</td>
<td>.35*</td>
<td>-.08</td>
<td>.04</td>
<td>.08</td>
<td>-.19</td>
<td>-.05</td>
<td>-.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-campus students (X4)</td>
<td>1.00</td>
<td>-.87*</td>
<td>-.06</td>
<td>.14</td>
<td>-.22</td>
<td>.18</td>
<td>-.21</td>
<td>-.01</td>
<td>-.01</td>
<td>-.30</td>
<td>-.01</td>
<td>-.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-campus students (X5)</td>
<td>1.00</td>
<td>.12</td>
<td>-.12</td>
<td>.15</td>
<td>-.26*</td>
<td>.13</td>
<td>.00</td>
<td>-.04</td>
<td>.17</td>
<td>-.00</td>
<td>.06</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer access (X6)</td>
<td>1.00</td>
<td>.20</td>
<td>-.12</td>
<td>-.17</td>
<td>.14</td>
<td>.19</td>
<td>-.06</td>
<td>.05</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Courses took (X7)</td>
<td>1.00</td>
<td>-.06</td>
<td>-.08</td>
<td>.07</td>
<td>.11</td>
<td>.10</td>
<td>.19</td>
<td>.02</td>
<td>.11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study hrs/week (X8)</td>
<td>1.00</td>
<td>.08</td>
<td>.26*</td>
<td>.37*</td>
<td>.36*</td>
<td>.41*</td>
<td>-.16</td>
<td>.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work hrs/week (X9)</td>
<td>1.00</td>
<td>.08</td>
<td>-.03</td>
<td>.17</td>
<td>-.05</td>
<td>-.22</td>
<td>-.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation* (X10)</td>
<td>1.00</td>
<td>.50*</td>
<td>.22</td>
<td>.16</td>
<td>.09</td>
<td>.53*</td>
<td>.50*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning Strategies (X11)</td>
<td>1.00</td>
<td>.26*</td>
<td>.31*</td>
<td>-.12</td>
<td>.50*</td>
<td>.53*</td>
<td>.50*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes (X12)</td>
<td>1.00</td>
<td>.32*</td>
<td>-.21</td>
<td>.21</td>
<td></td>
<td>.18</td>
<td>.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patterns of learning (X13)</td>
<td>1.00</td>
<td>.21</td>
<td>-.21</td>
<td>.18</td>
<td></td>
<td>.18</td>
<td>.18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEFT Score (X14)</td>
<td>1.00</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
<td>.09</td>
<td>.09</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Achievement* (Y)</td>
<td></td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Gender (0=male; 1=female)

Class (0=Zoology 155; 1=Biology 109)

Class level (0=High school students; 1=University students)

On-campus students (1=On-campus students; 0=Off-campus students; 0=Adult students)

Off-campus students (0=On-campus students; 1=Off-campus students; 0=Adult students)

Computer access (0=Limited; 1=Unlimited)

Number of courses taken previously in the same subject areas

Hours per week students spent studying in the Web-based courses they were taking

Hours per week students worked for pay

Mean scores of students' motivation in the Web-based learning

Mean scores of students' use of learning strategies

Mean scores of students' attitudes toward Web-based instruction

Mean scores of students' patterns of learning

Learning style scores

Standardized achievement scores

*p < .05
A hierarchical regression analysis was conducted to ascertain the amount of variance in the regression model (Table 22). The five learning factors of this study, attitudes, motivation, learning styles, learning strategies, and patterns of learning, were entered into the regression model. Student motivation was loaded first and explained 28% of the variance in their standardized achievement scores. Use of learning strategies was entered next into the regression. This variable explained an additional 7% of the variance in student achievement. Then attitude scores and scores for patterns of learning were entered into the regression, and none of them explained any additional variance in student achievement. Learning style score was then entered into the regression, and it explained an additional 1% of variance in student's achievement. The variables, motivation (t = 3.01) and use of learning strategies (t = 2.70), were significant for the explanation of variance in achievement scores. The results from the analysis revealed that a total of 35% of the variance in student achievement was accounted for by a combination of two significant variables, motivation and use of learning strategies.

Table 22
Hierarchical Entry Regression of Selected Variables on Standardized Achievement (n = 74)

<table>
<thead>
<tr>
<th>Variables</th>
<th>R²</th>
<th>R² Change</th>
<th>B</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>.28</td>
<td>.28</td>
<td>.65</td>
<td>3.01*</td>
</tr>
<tr>
<td>Learning strategies</td>
<td>.35</td>
<td>.07</td>
<td>.61</td>
<td>2.70*</td>
</tr>
<tr>
<td>Attitudes</td>
<td>.36</td>
<td>.01</td>
<td>.10</td>
<td>.65</td>
</tr>
<tr>
<td>Patterns of learning</td>
<td>.36</td>
<td>.00</td>
<td>.10</td>
<td>.30</td>
</tr>
<tr>
<td>GEFT score</td>
<td>.37</td>
<td>.01</td>
<td>.01</td>
<td>1.11</td>
</tr>
<tr>
<td>(Constant)</td>
<td></td>
<td></td>
<td>-5.08</td>
<td>-5.51</td>
</tr>
</tbody>
</table>

Note: B = Partial regression coefficient for each variable
F for the Model = 7.93; p < .05; (df 5, 68)
Standard Error = .82; Adjusted R² = .32
*p < .05
Prediction of Higher or Lower Achieving Students Based on Attitudes, Motivation, Learning Strategies, Patterns of Learning, Learning Styles, and Demographics

Discriminant analysis

Stepwise discriminant analysis was used to determine which variables could be used to predict student achievement. To use discriminant analysis, the data related to student achievement (z-score) was divided into higher achieving students and lower achieving students. The z-score of mean zero was used to classify students as higher achievers or lower achievers. Those whose z-scores were above zero were considered to be higher achievers (n = 40; 50%) and below zero, lower achievers (n = 34; 46%). Variables used for analysis were mean scores of attitudes, motivation, learning strategies, and patterns of learning, learning style (GEFT) scores, number of zoology or biology courses students had taken, student types (on-campus, off-campus, or adult students), computer access (limited or unlimited), working and studying hours per week, class (biology or zoology), class level (high school or university students), and gender. The nominal measurements, student types, computer access, class, class level, and gender, were dummy coded as shown in Table 21.

Table 21 presents the intercorrelations for the variables used in the procedure. Multicolinearity may be a problem when intercorrelations of .80 or higher are found. However, none of the variables used in the analysis correlated at .80 or higher so that multicolinearity was not a problem (Hinkle, Wiersma, & Jurs, 1994).

The eigenvalue is a special measure computed in the process of deriving the discriminant function. It is the proportion of explained variance for the discriminant score divided by the proportion of unexplained variance. The size of this value is positively associated with the discriminating power of the discriminant function (Klecka, 1980). The
eigenvalue for this discriminant analysis was .32 (Table 23). The canonical correction coefficient ($R_c$) for this discriminant analysis was .49, which shows a moderate association between the high and low achieving students and the discriminant score. According to Klecka (1980), the canonical correction coefficient is positively associated with the power of the relationship between the groups and the discriminant score. Additionally, the Wilks' Lambda is the proportion of variance in the discriminant score not explained by differences between the two groups (Klecka, 1980). The Wilks' Lambda was .76, which indicated a significant difference between the group centroids. The mean discriminant centroid for the high achieving students was .50 and for the low achieving students, it was -.61.

Table 23
Summary Data for Discriminant Analysis ($n = 74$)

<table>
<thead>
<tr>
<th>Variables</th>
<th>b</th>
<th>s</th>
<th>Group</th>
<th>Centroids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean of motivation</td>
<td>.69</td>
<td>.88</td>
<td>Higher achievers</td>
<td>.50</td>
</tr>
<tr>
<td>Mean of learning strategies</td>
<td>.51</td>
<td>.77</td>
<td>Lower achievers</td>
<td>-.61</td>
</tr>
<tr>
<td>Studying hours/week</td>
<td>--</td>
<td>.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean of patterns of learning</td>
<td>--</td>
<td>.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean of attitudes</td>
<td>--</td>
<td>.21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer assess</td>
<td>--</td>
<td>.11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEFT score</td>
<td>--</td>
<td>-.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working hours/week</td>
<td>--</td>
<td>.09</td>
<td></td>
<td></td>
</tr>
<tr>
<td>On-campus students</td>
<td>--</td>
<td>-.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Courses took in the subject areas</td>
<td>--</td>
<td>-.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td>--</td>
<td>-.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>--</td>
<td>-.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-campus students</td>
<td>--</td>
<td>-.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th>$R_c$</th>
<th>Willks' Lambda</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>.32</td>
<td>.49</td>
<td>.76</td>
<td>.00</td>
</tr>
</tbody>
</table>

Note: $b =$ Standardized discriminant function coefficient; $s =$ Within - groups structure coefficient; $R_c =$ canonical correlation coefficient
The stepwise discriminant analysis procedure yielded a set of two discriminating characteristics in which the higher and lower achieving students were expected to differ. Results show that higher achieving students had higher motivation scores and used more learning strategies.

The discriminant function resulted in an overall correct classification rate of 73% (Table 24). Higher achieving students were correctly classified 70% of the time, and lower achieving students were correctly classified 77% of the time.

Table 24
Discriminant Analysis Classification of Cases by Higher or Lower Achieving Students (n = 74)

<table>
<thead>
<tr>
<th>Actual Group</th>
<th>No. of Cases</th>
<th>Predicted Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High achievers</td>
</tr>
<tr>
<td>High achievers</td>
<td>40</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(70%)</td>
</tr>
<tr>
<td>Low achievers</td>
<td>34</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(23%)</td>
</tr>
</tbody>
</table>

Percent of "grouped" cases correctly classified: 73%

Summary

More than two-thirds of the respondents in this study were field-independent learners. Males (mean = 14.07) were more likely to be field-independent students, although the mean of female scores on the GEFT (mean = 11.76) also fell into the field-independent range. Field-independent and field-dependent students did not differ in study and work hours per week and number of courses taken previously in the biology or zoology subject areas.

Students' overall attitudes toward Web-based instruction were close to positive (mean = 3.49). The two most highly rated attitude statements were related to the convenience of
Web-based instruction and the ability to control the pace of learning. Additionally, students almost disagreed that learning through Web-based courses was boring (mean = 2.62). The overall mean for student motivation in Web-based learning was 3.48. The highest rated motivation was that the students wanted to get better grades than most other students. The second most highly rated item was that they expected to do well in the class. For the use of learning strategies in the Web-based courses, the overall mean score was 3.25. The most highly used learning strategies were to find the most important ideas from lectures and to relate the material to what they already knew. Students used least the learning strategies of making charts or tables to organize the material. The overall mean score for how often students used patterns of learning in Web-based courses was 2.88. The most highly used patterns of learning were checking scores of the tests or assignments and viewing the slides. Students used least the patterns of communicating with the class via e-mail, discussion net forum, and chat net forum. No significant differences were found between field-dependent and field-independent students in student achievement, attitudes, motivation, use of learning strategies, and patterns of learning.

According to the results of Pearson correlations, the higher achieving students were more likely to memorize key words of important concepts, connect the readings, expect to do well in this class, and value course material as useful. Results from linear hierarchical regression analyses showed that student learning styles, attitudes toward Web-based instruction, patterns of learning, and student characteristics -- whether or not they were university students, gender, previous experience in the biology or zoology subject area, study and work hours per week, student types, and access to computer -- did not affect student achievement in Web-based learning. Motivation and learning strategies were the only two
significant factors in Web-based courses, and they accounted for more than one-third of student achievement.

The discriminant analysis yielded a set of two discriminating characteristics in which the higher and lower achieving students were expected to differ. Results showed that higher achieving students had higher motivation scores and used more learning strategies. The discriminant function resulted in an overall correct classification rate of 73%.
CHAPTER V. DISCUSSION

Introduction

The purpose of this study was to evaluate how students with different learning styles learned and to identify factors influencing their achievement in Web-based courses. Objectives of the study were to identify:

a) demographic characteristics of the students in relation to their learning styles,

b) how attitudes, motivation, learning strategies, patterns of learning, and achievement differed in relation to students' learning styles,

c) relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning, achievement, and demographics, and

d) prediction of higher or lower achieving students based on attitudes, motivation, learning styles, learning strategies, patterns of learning, and demographics.

The discussions were organized under the following headings: (a) demographic data in relation to learning styles, (b) attitudes, motivation, learning strategies, patterns of learning, achievement, and learning styles, (c) relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning, achievement, and student characteristics, and (d) prediction of higher or lower achieving students based on attitudes, motivation, learning strategies, patterns of learning, learning styles, and demographics.

Demographic Data in Relation to Learning Styles

In this study, it was found that more than two-thirds of the respondents were field-independent learners. This was similar to Miller's finding (1997a) that distant learners in
agriculture were relatively more field-independent than the norm groups. It was also found
that the male learning style mean score (mean = 14.07) was significantly higher (at the .05
level) than the female score (mean = 11.76). The learning style mean score of all
respondents was 12.66. This was consistent with the preliminary norms data on GEFT, in
which college men (mean = 12.00) performed slightly but significantly better than college
women (mean = 10.8) (Witkin, Oltman, Raskin, & Karp, 1971). However, the GEFT mean
scores of both males and females in the Web-based courses were higher than the original
normative group reported by Witkin et al. (1971) in the GEFT manual. Web-based courses
require students to learn by themselves without the presence of instructors and classmates. It
was not surprising to find that many field-independent students took the Web-based courses.
This could be an effective support for marketing Web-based courses to the field-independent
learners, who often prefer learning by themselves (Witkin, Moore, Goodenough, & Cox,
1977).

Attitudes, Motivation, Learning Strategies, Patterns of Learning, Achievement, and Learning Styles

Attitudes

The two most highly rated attitude statements were related to the convenience of
Web-based instruction and the ability to control the pace of learning. This mirrors Miller’s
(1995b) results in his study of the Professional Agricultural Degree Program via videotaped
instruction. Moreover, one student replied to the open-ended question in the on-line
questionnaire regarding the reasons for taking the Web-based courses, “this course allows for
a flexible schedule and you can set your own pace.” Another student wrote that “it was much
more convenient for me and it sounded like a lot of fun.” And yet another student’s answer was: “I know it is a large lecture course [by taking it face-to-face] and I thought that I wouldn’t be missing any interaction by taking a web course.” Additionally, one high school student answered: “Basically I can get a head start on college. Plus, my high school pays for the courses.”

**Motivation**

In this study, getting better grades than other students and expecting to do well were the two most highly rated motivators for Web-based learning. Two motivation studies (Miller, 1992; Miller, 1995a) were found related to distance education in the *Journal of Agriculture Education* in the years from 1991 to 1997. However, these two studies investigated the participation factors that encouraged students to enroll in a certain program rather than the learning factors that motivated students to learn the course content as this current study did. In his study of participation motivation in off-campus agricultural credit programs, Miller (1992) found that cognitive interest was the highest motivator. Moreover, Miller (1995a) found that career advancement was the highest rated motivation factor for students to enroll in the off-campus agriculture program.

**Learning strategies**

Regarding the use of learning strategies, the first and second most highly used learning strategies were to find the most important ideas from lectures and to relate the material to what they already knew. These two learning strategies fell into the rehearsal and elaboration components of learning strategies in the *Motivation Strategies for Learning Questionnaire* (MSLQ) (Pintrich, Smith, Garcia, & McKeachie, 1991). This might be because the two Web-based courses, Zoology 155 and Biology 109, were introductory
courses. Weinstein and Keyer (1991) indicated that effective rehearsal and elaboration strategies were frequently used in introductory courses because the acquisition of basic knowledge is often a first step in the creation of a more extensive, integrated knowledge base in an area.

**Patterns of learning**

The most highly used pattern of learning was checking scores of the tests or assignments. This finding paralleled the most highly rated motivation finding which was that students wanted to get better grades than most other students. In this study, competition for scores seemed to be an important learning aspect in the introductory Web-based courses. According to the learning style literature (Witkin, Moore, Goodenough, & Cox, 1977; Miller & Honeyman, 1996), field-independent learners prefer competition, and two thirds of the respondents in this study were field-independent.

Is competition for scores a common learning aspect in all introductory undergraduate courses? Does learning through WWW encourage students to be competitive in learning? Or do instructors' attitudes, grading systems, and instruction design influence competition among students? Ames suggested that educators use criterion-based grading systems (Cross & Steadman, 1996), in which students' grades are based upon their successful completion of assigned tasks. Educators should present clear and explicit grading system procedures and criteria to reduce student competition and anxiety. Additionally, Johnson, Johnson, and Smith (1991) suggested that instead of encouraging competitive learning, educators should use the instructional design of cooperative learning; they found that cooperative learning promoted more productivity and achievement than did competitive learning.
Achievement and learning styles

Several studies (Annis, 1979; Moore & Dwyer, 1992; Ronning, McCurdy, & Ballinger, 1984) showed that field-independent learners tended to outperform field-dependent learners in various settings. However, in this study, it was found that field-independent students did not earn significantly higher achievement scores than field-dependent students did. In their study of the relationship between learning strategies and learning styles in a hypermedia environment, Liu and Reed (1994) also found that students with different learning styles achieved equally well, which mirrors the results of the study regarding the effect of learning styles on student achievement or attitudes in Web-based instruction conducted by Day, Raven, and Newman (1997).

Relationships Among Student Attitudes, Motivation, Learning Styles, Learning Strategies, Patterns of Learning, Achievement, and Demographics

Motivation and learning strategies

Student learning styles, attitudes toward Web-based instruction, patterns of learning, and student characteristics did not affect student’s Web-based learning achievement as measured by their class grades. Motivation and learning strategies were the two significant factors in Web-based learning that accounted together for more than one third (35%) of student achievement. The higher the student scored on motivation and use of learning strategies, the higher the student’s overall achievement in the class. This was supported in the studies made by Pintrich and Johnson (1990) and Weinstein and Underwood (1985). They indicated that effective and active learners, who usually used more motivational and learning strategies, learned more than students who used fewer strategies. Additionally, they
Garcia, 1995; Bandura, 1986; Zimmerman, 1989) indicated that students should monitor their learning motivation, regulate emotions, and use motivational and learning strategies for active involvement in learning.

Motivational and learning strategies are crucial aspects of self-regulated learning. Motivational strategies are those strategies students use to cope with the stress and emotions that are sometimes generated when they try to overcome occasional failures and become good learners (Garcia, 1995). Motivational strategies are means for negotiating the emotional outcomes of performance that affect one's sense of self-worth in self-regulated learning. And learning strategies are behaviors or methods that learners use to improve their understanding, integration, and retention of new information in the learning process (Cross & Steadman, 1996). Thus, self-regulated learning involves use of motivational and learning strategies to the degree that students are motivationally, metacognitively, and behaviorally active participants in their own learning processes (Zimmerman, 1989; Pintrich, 1995). This study found that motivation and learning strategies play important roles in Web-based learning, and this could be an effective support of self-regulated learning.

Learning Strategies and Learning Styles

In this study, the learning strategy variable was an effective factor in influencing student achievement; whereas the learning style variable was not. Learning style literature assumes stability and lack of individual control in the way learners perceive, organize, and react to different learning situations; however, learning strategy literature assumes that use of learning strategies can be controlled by learning and changed through teaching (Curry, 1990; Garger & Guild, 1984; Pintrich & Johnson, 1990). Because learners cannot change their learning styles, many of the learning style studies had the same implication and
recommendation that various teaching methods should be used to meet the needs of learners with different learning styles (Cano & Garton, 1994; Dyer & Osborne, 1996a; Dyer & Osborne, 1996b; Marrison & Frick, 1994; Miller, 1997b; Miller & Honeyman, 1996; Torres & Cano, 1994; Whittington & Raven, 1995). On the other hand, learning strategy literature opens another window for studies on teaching and learning. According to learning strategy literature, learners can gain better grades if educators instruct them how to use different learning strategies. That means educators should teach and encourage student use of learning strategies to help them achieve better grades. Using various teaching methods might not be the best resolution to help students learn better, because students as well as educators need to make an effort to improve learning. Teaching and learning are two-way efforts requiring two-way communication. Only asking educators to consider students' learning styles and adjust their teaching accordingly might not be as meaningful as suggesting that educators and learners make the effort together.

**Prediction of Higher or Lower Achieving Students**
**Based on Attitudes, Motivation, Learning Strategies, Patterns of Learning, Learning Styles, and Demographics**

In this study, results of discriminant analysis showed that higher achieving students had higher motivation and used more learning strategies in Web-based instruction than did lower achieving students. Two studies using discriminant analysis were presented at the 1998 Central Region Research Conference in Agricultural Education (Miller, 1998; Webster, Miller, & Doefert, 1998).
Miller (1998) used discriminant analysis to determine whether learner characteristics and individual learning strategy variables could be used to predict students who earned a grade of A in College of Agriculture videotaped courses. He found that students who earned A's spent less total time studying, spent more time viewing the videotape, scored higher on the GEFT, were more likely to use study methods, and were more likely to view the videotapes as they were received. However, in the current study, students' studying time for the Web-based courses, learning styles, and patterns of learning did not determine whether or not they were high achievers.

In a study determining if high school agricultural education seniors possessed the knowledge taught in a university level agriculture course, Webster, Miller, and Doefert (1998) used discriminant analysis to determine which variables could be used to predict whether or not high school students passed a university level agriculture examination. They found that experience in judging livestock, level of interest in animal science, membership in 4-H, experience showing livestock, and post high school educational plans were good predictors for whether or not students could pass the university level examination. The studies conducted by Webster et al. (1998) and Miller (1998) demonstrated that discriminant analysis was a good method to identify student characteristics and factors and could be used to predict audience types.
CHAPTER VI. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Introduction

The World Wide Web (WWW) is the latest in a long line of educational technologies. The World Lecture Hall lists almost 700 courses that are delivered by higher educational institutions via the Web, and this list is growing daily (Parson, 1998; World Lecture Hall, 1998). However, Parson (1998) and Alexander (1995) warned that as the popularity of the WWW increases, educators should evaluate how and why students learn via this new technology so as to help with curriculum and instructional designs. Parson (1998) added that it is important to understand how the new technology can affect learning when it is used by different types of learners.

Identifying students’ learning styles helps educators understand how people perceive and process information in different ways. Garger and Guild (1984, p. 11) described learning styles as “...stable and pervasive characteristics of an individual, expressed through the interaction of one’s behavior and personality as one approaches a learning task.” According to Cano, Garton, and Raven (1992), one of the most widely studied learning style theories contrasts field-dependence and field-independence. The Group Embedded Figures Test (GEFT), a standardized cognitive test, can be administered to determine the preferred learning styles of the learners as either field-dependent or field-independent (Oltman, Raskin, & Witkin, 1971).

Like the literature on learning styles, the literature on learning strategies explores different ways of learning (Pintrich & Johnson, 1990). Although they are similar in some
respects, these two literatures on learning styles and learning strategies have different assumptions about learning (Pintrich & Johnson, 1990). In assuming stability as well as lack of individual control, learning style literature suggests that it may be difficult for students to change their learning styles, whereas learning strategy literature assumes that students’ motivation and use of learning strategies can be controlled by learners and changed through instruction (Pintrich & Johnson, 1990). According to Cross and Steadman (1996), cognitive learning strategies are methods learners can use to improve their understanding, integration, and retention of new information. Learning strategies include a wide variety of cognitive processes and behavioral skills (Weinstein & Meyer, 1991). General learning strategy components include rehearsal, elaboration, organization, comprehension, metacognition, and resource management (Cross & Steadman, 1996; Weinstein & Meyer, 1991).

In their study on relationships between learning strategies and learning styles in a hypermedia environment, Liu and Reed (1994) used the term “patterns of learning” in discussing learning strategies. In Lui and Reed’s study, patterns of learning were measured by identifying how often the students accessed different functions in a hypermedia environment and how long students used the courseware. In this study, patterns of learning was defined as an indication of how often the students accessed different computer functions in Web-based courses.

Motivation is goal-directed behavior initiated and sustained by expectations concerning the anticipated outcomes of actions and self-efficacy for performing those actions (Bandura, 1986). Motivation influences how and why people learn as well as their performances (Pintrich & Schunk, 1996). Several researchers (Bandura, 1986; Garcia, 1995; Pintrich, 1995; Pintrich & Schunk, 1996; Zimmerman, 1989) believed that students may use
different motivational strategies in different learning situations and that students are able to become self-regulated learners. Motivational strategies are those strategies students use to cope with the stress and emotions that are generated when they try to overcome failures and become good learners (Garcia, 1995). One example would be desiring to get a better grade. Moreover, students can be described as self-regulated to the degree that they are motivationally, metacognitively, and behaviorally active participants in their own learning processes (Zimmerman, 1989).

In addition to motivation, student attitudes were the best predictors of student grades in a study on predicting student success (Hendrickson, 1997). Attitudes can be described as a person’s tendency to answer favorably or unfavorably to any discriminable aspect of the person’s world (Thompson, Higgins, & Howell, 1994).

Purpose and Objectives

What is known about the way students learn via WWW? What are the important learning factors in Web-based courses? Research is needed to identify learning factors that influence student success in Web-based courses. Such research will assist educators in planning, organizing, and delivering quality Web-based instruction in a manner that will improve student learning.

The purpose of this study was to evaluate how students with different learning styles learned and to identify factors influencing their achievement in Web-based courses. Objectives of the study were to identify:

a) demographic characteristics of the students in relation to their learning styles,

b) how attitudes, motivation, learning strategies, patterns of learning, and achievement differed in relation to students’ learning styles,
c) relationships among student attitudes, motivation, learning styles, learning strategies, patterns of learning, achievement, and demographics, and 

d) prediction of higher or lower achieving students based on attitudes, motivation, learning styles, learning strategies, patterns of learning, and demographics.

Methodology

This was a population study that included 99 students taking two non-major introductory Web-based courses, Zoology 155 and Biology 109, at Iowa State University. Seventy-four (75%) students who completed a learning style test (GEFT), an on-line questionnaire, and the Web-based courses by the end of the semester were considered to be an acceptable representation of the population. The Group Embedded Figures Test (GEFT) was used to determine preferred learning styles, either as field-dependent (FD) or field-independent (FI). The on-line questionnaire consisted of four scales (motivation, learning strategies, patterns of learning, and attitude), demographic questions about types of students as on-campus, off-campus, or adult students, number of courses taken previously in the subject area, study and work hours per week, class level, and gender, and an open-ended question about the reasons students took the Web-based courses. Cronbach’s alpha was used to assess the reliabilities of the four scales, whose pilot test coefficients ranged from .71 to .91. The questionnaire, written in HTML (HyperText Markup Language) format, was posted on the Web. Learning style scores, questionnaire responses, and student grades were matched yielding a final response rate of 74 (75%). Nonresponse error was then controlled using responses from those students who completed the GEFT after the deadline. Analyses of data included frequencies, means, standard deviations, t-tests, Pearson correlations,
multiple linear regression, and discriminant regression. The alpha level was established \textit{a priori} at the .05 level.

\textbf{Findings}

More than two-thirds of the respondents in this study were field-independent learners. Males (mean = 14.07) were more likely to be field-independent students, although the female (mean = 11.76) scores on the GEFT also fell into the field-independent range. Field-independent and field-dependent students did not differ in study and work hours per week and number of courses taken previously in the biology or zoology subject areas.

Students' overall attitude was uncertain, but close to positive (mean = 3.49) toward Web-based instruction. The two most highly rated attitude statements were related to the convenience of Web-based instruction and the ability to control the pace of learning. Additionally, students were close to disagreeing that learning through Web-based courses was boring (mean = 2.62).

The overall mean for student motivation in Web-based learning was 3.48. The highest rated motivation was that the students wanted to get better grades than most other students. The second most highly rated motivation was that they expected to do well in the class.

The overall mean score for the use of learning strategies in the Web-based courses was 3.25. The first and second most highly used learning strategies were to find the most important ideas from lectures and to memorize key words of important concepts. Students used least the learning strategy of making charts or tables to organize the material.

The overall mean score for how often students used patterns of learning in Web-based courses was 2.88. The first and second most highly used patterns of learning were checking
scores of the tests or assignments and viewing the slides. Students used least the patterns of
learning of communicating with the class via e-mail, discussion net forum, and the chat net
forum.

There were no significant differences at the .05 level between field-dependent
students and field-independent students in their achievement. Also they did not significantly
deriff in attitudes, motivation, use of learning strategies, and patterns of learning.

According to the results of Pearson correlations, the higher achieving students were
more likely to memorize key words of important concepts, connect the readings, expect to do
well in this class, and value course material as useful.

In the linear hierarchical regression analyses, results showed that student learning
styles, attitudes toward Web-based instruction, patterns of learning, and student
characteristics (university students or not, gender, previous experience in the biology or
zoology subject areas, study and work hours per week, student types, and access to
computer) did not affect their Web-based learning achievement. Motivation and learning
strategies were the two significant factors in Web-based learning, and they accounted for
more than one-third (35%) of student achievement.

The discriminant analysis yielded a set of two discriminating variables, motivation
and use of learning strategies, in which the higher and lower achieving students were
expected to differ. Results show that high achieving students had higher motivation scores
and used more learning strategies. The discriminant function resulted in an overall correct
classification rate of 73%.
Conclusions

The students in Web-based courses were more likely to be field-independent students. However, learning styles did not affect student achievement; field-independent and field-dependent learners were equally able to learn in Web-based courses. Students with different learning styles did not differ in their overall attitudes, motivation, learning strategies, and patterns of learning. Students enjoyed the convenience and self-controlled learning pace and were motivated by competition and high expectations in Web-based learning. They also used more rehearsal and elaboration learning strategies and fewer organizational learning strategies. Additionally, they seemed more interested in checking their grades than in communicating with the class.

High achieving students were more likely to memorize key words of important concepts, connect the readings, expect themselves to do well in the class, and value course material as useful. Student characteristics, attitudes towards Web-based instruction, and how often students accessed different computer functions did not affect their achievement. Rather, motivation and learning strategies were the two most important factors in student achievement in Web-based learning. Students were likely to be higher achievers in a Web-based course if they used more learning strategies and were more highly motivated to learn.

Recommendations and Implications

Based on the findings and the literature review, recommendations are made for educators, students, and researchers interested in Web-based learning. These recommendations may help increase the quality of Web-based courses. They may also increase students’ overall attitude toward Web-based learning, which in this study was above
the mid-point and close to being positive. Additionally, implications were made to the field of Agricultural Extension Education.

**Recommendations for educators**

Educators should understand student motivational factors and attitudes toward Web-based learning so that they can stimulate student motivation and get students actively involved in the learning process. Likewise, educators should provide students with information and opportunities to maintain healthy student competition and high expectations in Web-based learning, such as announcing mean scores of class tests for comparison, setting clear expectations for assignments and tests, and presenting clear and specific grading system procedures and criteria. Moreover, educators should provide students various learning opportunities to assure active learning and promote student achievement.

Educators should provide students with learning opportunities to use a variety of learning strategies in a manner to assure students’ understanding, integration, and retention of course concepts. Additionally, educators should encourage students to use more of the communicating techniques or functions, such as e-mail and discussion, and chat net forums, for more interactive learning in Web-based courses.

Several researchers (Pintrich & Johnson, 1990; Weinstein & Underwood, 1985) believed that students should monitor their learning motivation, regulate emotions, and use motivational and learning strategies for active involvement in learning. Sternberg (Cross & Steadman, 1996) has warned that it is not enough to teach students new learning strategies and students should be taught when to use the strategies and how to monitor and evaluate the success of using them. Educators should assist students in understanding and mastering different motivational and learning strategies to help them become self-regulated learners.
Motivational strategies are those strategies students use to cope with stress and emotions that are sometimes generated when they try to overcome occasional failures and become good learners (Garcia, 1995). Learning strategies are behaviors or methods that a learner uses to improve their understanding, integration, and retention of new information in the learning process (Cross & Steadman, 1996). Additionally, educators should encourage students to use more of the learning and motivational strategies which were used by the higher achievers in Web-based courses, such as memorizing key words of important concepts, connecting the readings, expecting themselves to do well in the class, and valuing course material as useful.

**Recommendations for students**

Students should learn to master different motivational and learning strategies and become self-regulated and successful learners. They should monitor their own learning motivation, regulate emotions, and use motivational and learning strategies for active involvement in learning. For example, they can evaluate for themselves what motivational and learning strategies they used in studying the course content, and how well they covered the course concepts. After each test, students should ask themselves why they succeeded or failed the tests and how to improve their study next time. They should often ask themselves whether they are motivationally, metacognitively, behaviorally active participants in their own learning processes. Why or why not?

According to the cognitive models of the information processing (Pintrich & Johson, 1990), to become active learners, students should make sure that they are able to (a) select the key points and the important information from lecture, discussions, and course reading, (b) integrate and connect the new information to their previous knowledge in order to understand the new information, and (c) remember and apply the new information in new
situations. To become higher achievers in Web-based courses, students should use more of the learning and motivational strategies: memorize key words of important concepts, connect the readings and concepts, expect themselves to do well, and value course material as useful.

**Recommendations for researchers**

Further research is needed to investigate the cause and effect of self-regulated learning by using an experimental design in a future study. Learning style literature was limited in implications that would help students become better learners and improve their achievement. More studies on motivation and learning strategies should be conducted to gain knowledge of helpful practices in teaching and learning.

**Implications for Agricultural Extension Education**

As Agricultural Extension increases its role in distance education, Extension educators should emphasize the importance of motivational and learning strategies in their non-formal educational programs to help participants become better learners. Moreover, Agricultural Extension Education should include activities in its curriculum that would help learners to master a variety of motivational and learning strategies. Findings from this study suggest that participants should be actively involved in monitoring their own learning.
APPENDIX A.

HUMAN SUBJECT REVIEW COMMITTEE APPROVAL
Checklist for Attachments and Time Schedule

The following are attached (please check):

12. □ Letter or written statement to subjects indicating clearly:
   a) purpose of the research
   b) the use of any identifier codes (names, #s), how they will be used, and when they will be
      removed (see Item 17)
   c) an estimate of time needed for participation in the research and the place
   d) if applicable, location of the research activity
   e) how you will ensure confidentiality
   f) in a longitudinal study, note when and how you will contact subjects later
   g) participation is voluntary; nonparticipation will not affect evaluations of the subject

13. □ Consent form (if applicable)

14. □ Letter of approval for research from cooperating organizations or institutions (if applicable)

15. □ Data-gathering instruments

16. Anticipated dates for contact with subjects:

    First Contact                      Last Contact

    Nov. 3, 97                     Nov. 30, 97

    Month / Day / Year            Month / Day / Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual
    tapes will be erased:

    Dec. 19, 1997

    Month / Day / Year

18. Signature of Departmental Executive Officer          Date          Department or Administrative Unit

    Patricia M. Keith            10-13-97            CAS

19. Decision of the University Human Subjects Review Committee:

    □ Project Approved    □ Project Not Approved    □ No Action Required

    Patricia M. Keith        10-19-97

    Name of Committee Chairperson          Date          Signature of Committee Chairperson

GC: 8/95
APPENDIX B.

LETTERS
October 28, 1997

Dear Teacher/Principal:

We are conducting a research study in the Department of Agricultural Education and Studies, Iowa State University. This study is to investigate the relationships of student motivation, learning strategies, learning styles, and achievement in the Biol 109 and Zool 155 web-based courses offered by Iowa State University in the fall of 1997. You might have received an e-mail message from the instructor of Biol 109 or Zool 155 about our study. We need the students to complete a learning style test, Group Embedded Figure Test (GEFT), under your supervision, and a Web-Based Learning Survey which will be posted on the web in November of this year. One copy of the sample GEFT and a draft copy of the survey is enclosed.

In order to help improve the web-based education, your and your students’ participation is very important for us to better understand why, how, and with what attitudes students are learning in the web-based course.

Please sign at the bottom of this letter if you are willing to be the proctor and for your students to participate in this study and return this letter by November 3. A reply envelope has been enclosed for your convenience. Thank you. We will send you the GEFTs in the near future if you are willing to participate.

Sincerely,

Ching-Chun Shih  Julia Gamon
Graduate Student    Professor

Teacher/Principal: Please sign here if you are willing to be the proctor and for your students to participate in our study. Thank you.

Please return by November 3 to Ching-Chun Shih, Room 6 Curtiss Hall, Iowa State University, Ames, IA 50011.
GROUP EMBEDDED FIGURES TEST

By Philip K. Ollman, Evelyn Flaskin, & Herman A. Wilkin

-simple forms

A

B

C

D

E

F

G

H

Consulting Psychologists Press, Inc.
3803 E. Bayshore Road • Palo Alto, CA 94303

INSTRUCTIONS: This is a test of your ability to find a simple form when it is hidden within a complex pattern.

Here is a simple form which we have labeled "X":

This simple form, named "X", is hidden within the more complex figure below:

Try to find the simple form in the complex figure and trace it in pencil directly over the lines of the complex figure. It is the SAME SIZE, in the SAME PROPORTIONS, and FACES IN THE SAME DIRECTION within the complex figure as when it appeared alone.

When you finish, turn the page to check your solution.
November 12, 1997

Dear Proctor:

We are conducting a research study in the Department of Agricultural Education and Studies, Iowa State University. This study is to investigate the relationships of student motivation, learning strategies, learning styles, and achievement in the Biol 109 and Zool 155 web-based courses offered by Iowa State University in the fall of 1997.

We need the students to complete a 12 minute learning style test, Group Embedded Figure Test (GEFT), under your supervision. Enclosed are the directions for you to read to the students while you are administrating the test. Please distribute the tests to your students. There are three sections in the test. Please read the directions for each section to the students and watch the time for them (Section 1 — 2 minutes; Section 2 — 5 minutes; Section 3 — 5 minutes). The students will need pencil and eraser in the test and their participation is voluntary. Their replies will be kept confidential.

Please return all of the tests. We will send a follow-up notice if we have not received a response from you by November 26. A reply envelope has been enclosed for your convenience. Thank you.

Happy Thanksgiving!

Sincerely,

Ching-Chun Shih
Graduate Student

Julia Gamon
Professor

Enclosure
Directions of the learning style test,
Group Embedded Figure Test (GEFT)
for the proctor to read to the students

- Now start reading the Directions, which include 2 practice problems for you to do. When you get to the end of the Directions on Page 3, please stop. Do not go beyond Page 3.
- Before I give the signal to start, let me review the points to keep in mind.
   1. Look back at the simple forms as often as necessary.
   2. Erase all mistakes.
   3. Do the problems in order. Don’t skip a problem unless you are absolutely “stuck” on it.
   4. Trace only one simple form in each problem. You may see more than one, but just trace one of them.
   5. The simple form is always present in the complex figure in the same size, the same proportions, and facing in the same direction as it appears on the back cover of this booklet.
- Are there any questions about the directions? Raise your hand if you need a new pencil during the test.
- When I give the signal, turn the page and start the First Section. You will have 2 minutes for the 7 problems in the First Section. Go ahead.

(After 2 minutes)
- STOP -- Whether you have finished or not. When I give the signal, turn the page and start the Second Section. You will have 5 minutes for the 9 problems in the Second Section. You may not finish all of them, but work as quickly and accurately as you can. Raise your hand if you need a new pencil during the test. Ready, go ahead.

(After 5 minutes)
- STOP -- Whether you have finished or not. When I give the signal, turn the page and start the Third Section. You will have 5 minutes for the 9 problems in the Third Section. Raise your hand if you need a new pencil during the test. Ready, go ahead.

(After 5 minutes)
- STOP -- Whether you have finished or not. Please close your test booklet and hand it to your proctor.
Dear Biol 109 student:

We are conducting a research study in the Department of Agricultural Education and Studies, Iowa State University. This study is to investigate the relationships of motivation, learning strategies, learning styles, and student achievement in the Biology web-based course. Your participation is very important to us and your input is necessary to help us better understand why, how and with what attitudes students are learning in the web-based courses in order to improve the web-based education.

You will be given a learning style test (GEFT) by your proctor today. The GEFT is a perceptual test which will help us identify your learning style. Please follow your proctor's direction to complete this learning style test as accurately as possible. It will take 20 minutes of your time.

Your participation in this test is voluntary. We appreciate the time you are taking to assist us. Please respond to the learning style test and return it to your proctor. If you feel you do not have the time available for this study, please return the learning style test and indicate such on this cover letter.

Your responses will be kept strictly confidential with coding of the questionnaires used for data analysis purposes. We will send a follow-up notice if I have not received a response from you by November 14. Coding will be removed at the time of final data processing.

Upon completion of the learning style test, please hand it in to your proctor.

Sincerely,

Ching-Chun Shih
Graduate Student

Julia Gamon
Professor
APPENDIX C.

ON-LINE QUESTIONNAIRE
Web-Based Learning Survey

A. Motivation

Directions: Please try to rate yourself according to how well the statement describes you while you are taking this web-based course based on the following key:

- Not at all typical of me
- Not very typical of me
- Somewhat typical of me
- Quite typical of me
- Very much typical of me

1) I think the course material in this class is useful for me to learn.
- Not at all typical of me
- Not very typical of me
- Somewhat typical of me
- Quite typical of me
- Very much typical of me

2) In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.
- Not at all typical of me
- Not very typical of me
- Somewhat typical of me
- Quite typical of me
- Very much typical of me

3) When I take a test I think about items on other parts of the test I can't answer.
- Not at all typical of me
- Not very typical of me
- Somewhat typical of me
- Quite typical of me
- Very much typical of me

4) If I can, I want to get better grades in this class than most of the other students.
- Not at all typical of me
- Not very typical of me
- Somewhat typical of me
- Quite typical of me
- Very much typical of me

5) I expect to do well in this class.
6) The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.

   O Not at all typical of me
   O Not very typical of me
   O Somewhat typical of me
   O Quite typical of me
   O Very much typical of me

7) I am very interested in the content area of this course.

   O Not at all typical of me
   O Not very typical of me
   O Somewhat typical of me
   O Quite typical of me
   O Very much typical of me

8) When I take a test I think about how poorly I am doing compared with other students.

   O Not at all typical of me
   O Not very typical of me
   O Somewhat typical of me
   O Quite typical of me
   O Very much typical of me

9) If I study in appropriate ways, then I will be able to learn the material in this course.

   O Not at all typical of me
   O Not very typical of me
   O Somewhat typical of me
   O Quite typical of me
   O Very much typical of me

B. Learning Strategies

Directions: Please try to rate yourself according to how well the statement describes you while you are taking this web-based course based on the following key:

Very much typical of me
Quite typical of me
Somewhat typical of me
Not very typical of me
Not at all typical of me

10) When studying for this class, I read my class notes and the course readings over and over again.

   O Not at all typical of me
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td><strong>11)</strong> I memorize key words to remind me of important concepts in this class.</td>
<td></td>
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<tr>
<td></td>
<td>Not at all typical of me</td>
<td>Not very typical of me</td>
<td>Somewhat typical of me</td>
<td>Quite typical of me</td>
</tr>
<tr>
<td><strong>12)</strong> When reading for this class, I try to relate the material to what I already know.</td>
<td></td>
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<tr>
<td></td>
<td>Not at all typical of me</td>
<td>Not very typical of me</td>
<td>Somewhat typical of me</td>
<td>Quite typical of me</td>
</tr>
<tr>
<td><strong>13)</strong> I try to understand the material in this class by making connections between the readings and the concepts from the lectures.</td>
<td></td>
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<tr>
<td></td>
<td>Not at all typical of me</td>
<td>Not very typical of me</td>
<td>Somewhat typical of me</td>
<td>Quite typical of me</td>
</tr>
<tr>
<td><strong>14)</strong> When I study for this course, I go through the readings and my class notes and try to find the most important ideas.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Not at all typical of me</td>
<td>Not very typical of me</td>
<td>Somewhat typical of me</td>
<td>Quite typical of me</td>
</tr>
<tr>
<td><strong>15)</strong> I make simple charts, diagrams, or tables to help me organize course material.</td>
<td></td>
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<tr>
<td></td>
<td>Not at all typical of me</td>
<td>Not very typical of me</td>
<td>Somewhat typical of me</td>
<td>Quite typical of me</td>
</tr>
<tr>
<td><strong>16)</strong> I try to play around with ideas of my own related to what I am learning in this course.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Not at all typical of me</td>
<td>Not very typical of me</td>
<td>Somewhat typical of me</td>
<td>Quite typical of me</td>
</tr>
</tbody>
</table>
17) Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.
   - Not at all typical of me
   - Not very typical of me
   - Somewhat typical of me
   - Quite typical of me
   - Very much typical of me

18) I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying.
   - Not at all typical of me
   - Not very typical of me
   - Somewhat typical of me
   - Quite typical of me
   - Very much typical of me

19) When I study for this class, I try to determine which concepts I don't understand well.
   - Not at all typical of me
   - Not very typical of me
   - Somewhat typical of me
   - Quite typical of me
   - Very much typical of me

20) I rarely find time to review my notes or readings before an exam.
   - Not at all typical of me
   - Not very typical of me
   - Somewhat typical of me
   - Quite typical of me
   - Very much typical of me

21) I make good use of my study time for this course.
   - Not at all typical of me
   - Not very typical of me
   - Somewhat typical of me
   - Quite typical of me
   - Very much typical of me

22) When course work is difficult, I give up or only study the easy parts.
   - Not at all typical of me
   - Not very typical of me
   - Somewhat typical of me
   - Quite typical of me
   - Very much typical of me

C. Your feelings about web-based instruction
Directions: Please indicate the extent to which you agree with the following statements about web-based instruction.

Strongly Agree
Agree
Undecided
Disagree
Strongly disagree

23) I enjoy learning from the web-based lessons.
   O Strongly Disagree
   O Disagree
   O Undecided
   O Agree
   O Strongly Agree

24) Web-based courses should be utilized more often to deliver instruction.
   O Strongly Disagree
   O Disagree
   O Undecided
   O Agree
   O Strongly Agree

25) I feel more isolated as a student when I take courses via the web.
   O Strongly Disagree
   O Disagree
   O Undecided
   O Agree
   O Strongly Agree

26) I will recommend web-based courses to my friends.
   O Strongly Disagree
   O Disagree
   O Undecided
   O Agree
   O Strongly Agree

27) Learning through web-based instruction is convenient.
   O Strongly Disagree
   O Disagree
   O Undecided
   O Agree
   O Strongly Agree

28) Web-based courses allow me to control the pace of my learning.
   O Strongly Disagree
   O Disagree
29) I prefer web-based courses to traditional classroom instruction.
- Undecided
- Agree
- Strongly Agree

30) Learning through web-based courses is boring.
- Strongly Disagree
- Disagree
- Undecided
- Agree
- Strongly Agree

31) I will enroll in another web-based course.
- Strongly Disagree
- Disagree
- Undecided
- Agree
- Strongly Agree

32) Web-based courses provide me with learning opportunities that I otherwise would not have had.
- Strongly Disagree
- Disagree
- Undecided
- Agree
- Strongly Agree

33) I would not have taken web-based courses if I had some other means of acquiring course credit.
- Strongly Disagree
- Disagree
- Undecided
- Agree
- Strongly Agree

34) I need more information about the tests.
- Strongly Disagree
- Disagree
- Undecided
- Agree
- Strongly Agree

35) I would prefer to take the tests on paper rather than on computer.
36) I would like to see as well as hear the instructor on the web.  
O  Strongly Disagree  
O  Disagree  
O  Undecided  
O  Agree  
O  Strongly Agree

37) I need reassurance about whether I am on schedule for the course.  
O  Strongly Disagree  
O  Disagree  
O  Undecided  
O  Agree  
O  Strongly Agree

38) I have technical problems with the use of the computer.  
O  Strongly Disagree  
O  Disagree  
O  Undecided  
O  Agree  
O  Strongly Agree

D. Learning Patterns

Directions: Please indicate how often you use the following learning patterns to learn each lesson while you are taking this web-based course.

All of the time  
Most of the time  
Some of the time  
Part of the time  
None of the time

39) View the slides  
O  None of the time  
O  Part of the time  
O  Some of the time  
O  Most of the time  
O  All of the time

40) View the slides more than once  
O  None of the time  
O  Part of the time
41) Listen to the audio of the lessons
- None of the time
- Part of the time
- Some of the time
- Most of the time
- All of the time

42) Listen to the audio more than once
- None of the time
- Part of the time
- Some of the time
- Most of the time
- All of the time

43) Take notes while viewing the slides
- None of the time
- Part of the time
- Some of the time
- Most of the time
- All of the time

44) Take notes while listening to the audio of the lessons
- None of the time
- Part of the time
- Some of the time
- Most of the time
- All of the time

45) Use lecture note course package
- None of the time
- Part of the time
- Some of the time
- Most of the time
- All of the time

46) Read textbook
- None of the time
- Part of the time
- Some of the time
- Most of the time
- All of the time

47) Use CD ROM
48) Interact with instructor
○ None of the time
○ Part of the time
○ Some of the time
○ Most of the time
○ All of the time

49) Communicate with the class via e-mail
○ None of the time
○ Part of the time
○ Some of the time
○ Most of the time
○ All of the time

50) Communicate with the class via discussion netforum
○ None of the time
○ Part of the time
○ Some of the time
○ Most of the time
○ All of the time

51) Communicate with the class via chat netforum
○ None of the time
○ Part of the time
○ Some of the time
○ Most of the time
○ All of the time

E. Information about you

Directions: Please indicate the response that best describes your situation.

52) How many other high school (and college) level courses have you had in this subject area?
courses

53) How many hours a week do you spend studying for this course?
hours/week

54) How many hours a week do you work (for pay)?
hours/week

55) What is your access to the web-based course? (Choose one)
56) What is your class level? (Choose one)
   High school
   - 9th grade
   - 10th grade
   - 11th grade
   - 12th grade
   OR
   University
   - Freshman
   - Sophomore
   - Junior
   - Senior

57) Gender (Choose one)
   - Male
   - Female

58) Why are you taking the web-based course(s)?

59) Please describe how you study for this course? For example, view the slides first, then listen to the audio and take notes at the end.
REFERENCES


ACKNOWLEDGEMENTS

I would like to acknowledge and thank those persons who have contributed their time, understanding, and cooperation towards the completion of my Ph.D. degree.

I am most grateful to my major professor, Dr. Julia Gamon, for her supervision, guidance, encouragement, and dedication of time during the period of my academic life at ISU. Special thanks are expressed to my committee members, Dr. Cheryl Hausafus, Dr. Robert Martin, Dr. Wade Miller, and Dr. David Williams for their direction and contribution. In addition, I am truly grateful to Dr. Tom Ingebritsen, Dr. John Pleasants, Kathleen Flickinger, and Dr. George Brown of Project BIO for their assistance and support in the online survey and data collection process.

My greatest thanks goes to my parents, Mr. and Mrs. Su-Chen Shih, my husband, Chih-Ming Chen, and my son, Yen-Shuo Chen, for their love, understanding, and patience throughout this process.

How fortunate I have been – and how gratefully I now acknowledge each of you.