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UMI
LEVELS OF COGNITION OF INSTRUCTION AND OF STUDENTS' REFLECTIVE THINKING IN A SELECTED WEB-ENHANCED COURSE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By

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The Ohio State University
2001

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ABSTRACT

The development of cognitive instruction, critical thinking, higher level of thinking and problem solving ability in students has been of great concern in the recent past. One way to examine the quality of instruction is to assess the cognitive levels of the teaching and students' reflective thinking. The purpose of this study was to describe the cognitive level of instruction and students' reflective thinking of a selected web-enhanced course at The Ohio State University. The target population for the study consisted of a web-enhanced course at OSU and thirteen graduate students who were enrolled in this course during the Spring Quarter of 2001. In this study, the modified version of Newcomb and Trefz's taxonomy was adopted to assess the cognitive level of teaching and students' reflective thinking. Based on Bloom's taxonomy, Newcomb and Trefz (1987) developed the modified version, which included four specific levels: (1) remembering, (2) processing, (3) creating and (4) evaluating. The results indicated that the most common cognitive level utilized by both teachers and students were the "processing" level and the "remembering" level was utilized least frequently of both of them. Results showed little difference existed between the distributions of the cognitive level of in-class and on-line instruction; however, the results did show that out-of-class assignments attained a higher
cognitive level than in-class discourse and on-line course content. The “creating” level was the most common cognitive level utilized in out-of-class assignments. A training program is recommended for teachers who will teach a web-enhanced or web-based course. The program should contain: (1) familiarity with the technology, (2) on-line class management skills and (3) pedagogical training, such as: higher cognitive level of teaching and the objective classification system. In order to achieve higher cognitive level of thinking, students are recommend to (1) check the course website at least once a week to be familiar and ready to learn a new topic, (2) contact the instructor via e-mail, on-line discussion and chat rooms when they encountered difficulty in understanding course materials and (3) apply the knowledge they learned to their own practical situations.
DEDICATION

To My Parents: Fong-rong Kao and Mei-heh Tsai
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I would like to express my heartfelt gratitude to those who have helped me through my graduate studies.

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CHAPTER 1

INTRODUCTION

The Web-based Education Commission was established by Congress to explore the policy and pedagogical issues surrounding the use of the World Wide Web in the field of Education. The mission of the Web-based Education Commission is to recommend actions to help ensure that all learners have full and equal access to the capabilities of the World Wide Web, and to ensure that online content and learning strategies are affordable and meet the highest standards of educational quality (Web-based Education Commission Webpage).

Students who learn with the tools and content of the Internet must have ready access to its supporting technology. Based on the illustration of the Web-based Education Commission, "access" is more than getting one's hands on a computer, or simply connecting to the Internet. Other than being convenient and affordable, "access" also implies that once a user has the connection and is able to use it, he or she can find content and applications that have meaning and value for his or her learning needs.
In order to better understand the impacts and improvements the World Wide Web can have in the area of Education, the Web-based Education Commission proposed some pedagogy issues of web-based courses:

- How must traditional teaching and learning strategies change in order to take full advantage of the capabilities of the World Wide Web?
- What is the potential of the Web to improve achievement among learners?
- What are the content and teaching strategies that best utilize the Internet for learning?
- How can we assure that new web-based learning strategies lead to dramatic improvement in achievement?
- What measurements of effectiveness are required to assure that new web-based learning approaches lead to significant achievement?

Web-based distance education

The rapid development of computer networking capacity culminating in the Internet has encouraged and enabled distance learning to take place more effectively (Rossman & Rossman, 1995). Distance learning programs can be designed to meet any group of learners’ needs. The technologies used in distance learning, the structure of a course or a program, and the degree of supervision for a distance learning course can be varied to meet a particular group’s needs or interests (Porter, 1997).

The World Wide Web (WWW or Web) has become one of the most popular methods of disseminating distance learning programs. Porter (1997) stated that, in fact,
if learners and educators do not need face-to-face communication during the course, it is one of the best methods of providing information for learners. For educators, a benefit of the Web is that the types of information that can be used in a course are almost limitless. Because the information is stored electronically, learners with access to the site can download or use online information as long as it is stored there. That makes it easy for learners to work at their own pace and to visit the site as frequently as they like, whenever they have time (Porter, 1997).

Adults, whose work and personal schedules do not permit them to attend classes scheduled by a university in their area, can take distance learning courses at their convenience. Adults or youth who do not like to participate in other types of educational programs can receive similar instruction at home or in another setting. Persons with different abilities, which may make it difficult to participate at the same pace or in the same way as other learners in a classroom, may participate fully by using specially designed materials that enhance their learning (Porter, 1997). Moore (1990) stated that distance education is private and typically between two individuals rather than public, in large face-to-face groups, as classroom teaching often is. According to Moore's discussion, although distance education does not offer physical closeness, it does have the potential to offer closer psychological proximity than large, auditorium-type classes.

Truman & Hartman (1998) stated that active, high quality participation in on-line environments requires students to take more responsibility for their own learning and faculty to balance their role as facilitator and coach. Faculties need balance as they
retain their roles as content experts and to facilitate deeper student learning by explaining, clarifying, directing and helping learners construct their own knowledge. Truman & Hartman (1998) also emphasized that course production is best done when faculty have taken sufficient time to examine their pedagogical goals.

**Cognitive instruction in web-based distance education**

Educators generally agree that teachers should emphasize the development of students' skill in critical thinking rather than in learning and recalling facts (Gall, 1970). A long standing debate in U.S. education is whether schools should direct their efforts to teaching students how to think, rather than what to think (Bruning et al., 1999).

Cognitive instruction refers to any effort in teaching or in designing instructional materials to help students process information in meaningful ways and to become independent learners (Idol, Jones & Mayer, 1991). Idol et al. (1991) stated that this definition includes efforts to help students construct meaning from text, solve problems, select and develop effective thinking strategies, and take responsibility for their own learning, as well as to transfer skills and concepts to new situations. Webb (1970) stated that it has been assumed that the school's main task has been to promote intellectual activity; hence, the analysis of cognitive behavior is of major importance in investigating the educational process.

The theory for cognitive research has been based on the Taxonomy of Educational Objectives, Book I: Cognitive Domain. (Bloom, Engelhart, Furst, Hill & Krathwohl, 1956). Bloom's taxonomy contains six major levels which are knowledge,
comprehension, application, analysis, synthesis and evaluation. This taxonomy represents a hierarchical order, from low brain activity requirements to high brain activity requirements. Newcomb and Trefz (1987) modified Bloom's Taxonomy of Educational Objectives. In their modification, Bloom's six levels were collapsed into four levels: remembering, processing, creating and evaluation. The remembering level is similar to Bloom's knowledge level; the processing level is a combination of the comprehension, application, and analysis levels. The creating level, which is similar to Bloom's synthesis level, is the next in their hierarchical order. The evaluating level in both classifications of educational objectives is the highest level of cognitive activity.

**Problem statement**

Distance learning has become a hot topic in the past few years. Microcomputers, the Internet, and the WWW are shaping the current generation of distance learning, and virtual reality, artificial intelligence, and knowledge systems may be next (Kerka, 1996). Saba (1999) stated that one of the most important implications of distance learning is that students must take more responsibility for their learning.

Distance education may change the traditional teaching and learning process. With a web-based course, information is stored electronically; students can download the information or use it on the web whenever they want. Students have more flexibility and responsibility for their own learning and, yet, the role of the teacher becomes more important, because their instruction on the web may have a big influence on students even though they do not see each other. Distance education has been
expected to perform its educational role more efficiently and effectively than traditional education. A successful distance education program should be able to provide high quality instruction. One way to examine the quality of instruction would be to assess the cognitive levels of the web-based distance education program.

Need for study

In the past few years, studies have been conducted to examine the level of cognition of teaching and learning in various settings (Bhardwaj, 1989; Newcomb & Trefz, 1987; Squire, 1993; Whittington, 1991, Miller & Chen, 1994 and Dlamini, 1996). However, no study has investigated the level of cognition of teaching distance education and no study has described the levels of cognition of students’ reflective thinking about a web-enhanced course. In order to improve heuristic teaching and to encourage higher cognitive learning through the application of web-enhanced courses, researchers need to know more about the current cognitive level of web-enhanced courses. Therefore, this study sought to describe the levels of cognition of a selected web-enhanced course and describe the levels of cognition of students’ reflective thinking about this web-enhanced course at The Ohio State University. The study also sought to compare the levels of cognition of instruction and the levels of cognition of students’ reflective thinking about the course. Through the study of the web-enhanced course, the intention of the researcher is to gain insights that will suggest ways to help the pedagogical development of other web-enhanced or web-based courses.
Purpose of the study

The purpose of this study was to describe the cognitive level of instruction of a selected web-enhanced course and describe the cognitive level of students’ reflective thinking in the course at The Ohio State University.

Objectives of the study

To achieve the purpose of the study, three research objectives are proposed to:

1. Describe the levels of cognition of the teaching materials of a selected web-enhanced course.

2. Describe the levels of cognition of students’ reflective thinking about the teaching materials.

3. Compare the levels of cognition of the teaching materials and levels of cognition of students’ reflective thinking.

Definition of Terms

1. Distance education: Distance education refers to a special style of education that learners are physically distant from the source of the information and instruction (Porter, 1997).

2. Web-based learning courses: A web-based learning course is one of the distance education types. Once learners have subscribed to, or signed up for, a free or purchased Internet provider, they gain access to the educational materials and services designed for the Internet and World Wide Web (Porter, 1997).
3. **Level of cognitive instruction**: The classification system developed by Newcomb and Trefz (1987) to classify the educational objectives of an educational program into four levels of cognition: remembering, processing, creating and evaluation. In this study, the *operational definition* of level of cognitive instruction is the proportion of total observed cognitive statements in the teaching materials, assignments and exams of the web-based course, which was measured by the modified the Florida Taxonomy of Cognitive Behavior instrument. The largest proportion of total observed cognitive statements of a specific cognitive level indicated the level at which the teacher tended to teach.

**Limitations of the study**

This study was exploratory in nature and, thus, was designed as a descriptive study. Due to the lack of time, financial support and professors' agreement to participate, the study was restricted to the level of cognitive instruction and the level of students' reflective thinking of one selected web-enhanced course at OSU.

In this study, the sample course was selected purposively. Thus, the study can not make unbiased inferences to populations and the generalization of the results would be limited. However, this study emphasized designing the study to optimize understanding of the case rather than generalization beyond (Stake, 1998). It is of value in refining theory and suggesting complexities for further investigation (Stake, 1998).
Cognitive instruction

Cognitive instruction refers to any effort in teaching or in designing instructional materials to help students to process information in meaningful ways and to become independent learners (Idol, Jones & Mayer, 1991). Idol et al. (1991) stated that this definition includes efforts to help students construct meaning from text, solve problems, select and develop effective thinking strategies, and take responsibility for their own learning, as well as to transfer skills and concepts to new situations.

In some courses, the educators who prepare materials and direct the course are actively involved in working with learners. In more highly structured courses, learners usually have more direct interaction with educators, who may evaluate the learners’ progress and provide a final ‘grade’ or other signifier that learners have achieved course objectives (Porter, 1997).

Idol et al. (1991) stated that the overall goals of cognitive instruction differ from traditional instruction. Most traditional instruction focused on content covered and transfer and application of specific skills. However, the overall goals in cognitive
instruction are (a) to teach to understand in all subject areas and (b) to help students learn how to learn (Novak & Gowin, 1984). Regarding the “learning how to learn” goal, it refers not only to independent application of specific strategies but also to self-appraisal and self-regulation of the process of learning, including efforts to set learning goals and assess what has been learned. Webb (1970) stated that it has been assumed that the school’s main task has been to promote intellectual activity; hence the analysis of cognitive behavior is of major importance in investigating the educational process.

Newcomb and Trefitz (1987) and Miller (1990) recommended the use of information about the cognitive levels of learning to educators in all areas of instruction: (1) in the design of learning activities or use in the classroom and outside of class; (2) in the development of text items and (3) in the development of behavioral objectives.

Asking questions as a tool to achieve higher cognitive level teaching

For educators, questions play an important role in teaching (Gall, 1970). Ascher (1961) called the teacher “a professional question maker” and claimed that the asking of questions is “one of the basic ways by which the teachers stimulate student thinking and learning.” Gall (1970) stated that most of the question-classification systems are composed almost entirely of categories based on the type of cognitive process required to answer the question. For example, in Bloom’s Taxonomy, the question “what is your opinion of our present stance on the Vietnam War?” is classified as an Evaluation question because it requires evaluative thinking, whereas “what assumptions does the author make in criticizing New Deal politics” is classified as an Analysis question.
because it required that students engage in analytic thinking (Gall, 1970). Bloom’s Taxonomy best represents the commonalties that exist among the systems (Gall, 1970).

Bloom (1956) stated that students might answer an analysis or synthesis question by recalling what they heard or read about instead of presenting their own thinking. As a result, Gall (1970) stated that teachers’ “follow up” questions and use of effective question sequencing are needed. Sanders (1966) stated that good questions recognize the wide possibilities of thought and are built around varying forms of thinking. Good questions are directed toward learning and evaluative thinking, rather than what has been learned in a narrow sense. Some instructors intuitively ask questions of high quality, but many overemphasize those that require the learner only to remember, and practically no instructors make full use of all worthwhile questions.

Sanders (1990) illustrated questions at the various cognitive level based on Bloom’s taxonomy:

1. Knowledge: questions at this level can be considered to comprise the building blocks for other levels of intellectual functioning. Such questions tend to emphasize the parroting of information. They deal with the identification and recall of information such as: who, what, where, when and how.

2. Comprehension: comprehension questions ask the learner to show an understanding of the literal message contained in a communication (the learner is required to organize and select facts and ideas) or to discover or use a relationship between two or more ideas.

3. Application: application questions require the learner to apply what has been
learned to other situations and learning tasks. The instructor does not explicitly relate exactly how the learner should function with the information. Part of the challenge lies in the learner's ability to determine the appropriate process to use. The central idea is that the learner deals with data or solves some type of problem.

4. Analysis: analysis questions require a lot of thought to formulate. They require the learner to separate a whole into component parts including elements, relationships, and organizational principles.

5. Synthesis: synthesis questions encourage learners to engage in imaginative, original thinking (Sander, 1966). These questions require the learners to organize the information they have obtained or considered at the lower levels of learning. In synthesis, the learner must draw upon elements from many sources and put these together into a structure or pattern not clearly there before. Synthesis questions allow learners great freedom in seeking solutions to problems; however, a learning environment that seeks and rewards originality must be fostered for these questions to have their greatest impact.

6. Evaluation: these questions ask the learner to make judgments about the value, for some purpose, of ideas, works, solutions, methods, materials, etc. The answers involve the use of criteria as well as standards for appraising the extent to which particulars are accurate, effective, economical or satisfying (Sanders, 1990).

**Critical thinking**

Educators generally agree that teachers should emphasize the development of
students' skill in critical thinking rather than in learning and recalling facts (Gall, 1970). Several strands of researches suggested that what people think about how students learn has a lot to do with what is taught in the classroom and how it is taught. Bruning et al. (1999) stated that a long-standing debate in U.S. education is whether schools should direct their efforts to teaching students how to think, rather than what to think.

Bruning et al. (1999) stated that critical thinking is a reflective activity and its goal is not to solve a problem but rather to better understand the nature of the problem. Critical thinking is focused on thinking about something we wish to understand more thoroughly. It is also a better way of thinking that will improve our ability to gather, interpret, evaluate and select information for the purpose of making informed choices.

According to Ennis's (1987) definition of critical thinking, it is reflective thinking focused on deciding what to believe or do. Ennis (1987) proposed twelve critical thinking abilities: (1) focusing on the question, (2) analyzing arguments, (3) asking and answering questions of clarification, (4) judging the credibility of a source, (5) observing and judging observational reports, (6) deducing and judging deductions, (7) inducing and judging induction, (8) making value judgments, (9) defining terms and judging definitions, (10) identifying assumptions, (11) deciding on an action and (12) interacting with others. Ruggieri (1988) defined critical thinking as any mental activity that helps formulate or solve a problem, make a decision, or fulfill a desire to understand; it is a searching for answers, a searching for meaning.
Ruggieri (1988) stated that it might be reasonable to argue that all good teachers encourage students to think but that is not the same as teaching students how to think. Teaching how to think means providing students first with knowledge of the principles and techniques of creative and critical thinking, and second with regular guided practice in applying those principles and techniques to problem solving and decision making situations. Ruggieri (1988) also proposed an important concept: to teach thinking across the curriculum. It means going beyond filling students with information and admiration of other people's competencies to developing their own competencies so that they can deal with a logical situation which they encounter.

The need for critical thinking

Renewed interest in critical thinking rivals problem solving as the major focus of higher order cognitive operations in the current educational movement (Presseisen, 1987). When Bloom talked about the crucial need for lifelong learning, he stated that people needed to gain new knowledge to enable them to cope with rapid change and prepare them to deal with the more and more complex problems. Bloom further stated that from both the public and the governmental point of view, education is being increasingly recognized as an effective means for solving problems of society. Adult and continuing educators must draw on cognitive learning theory to confront these uncertain learning situations. Therefore, teaching students how to think and deal with rapidly changing problems becomes the essences of education.

Presseisen (1987) stated that critical thinking encourages students to challenge assumptions in order to clarify situations, then, to use the logical and psychological
powers they have to determine accurate judgments. Pressceisen proposed several insights on teaching critical thinking for the nation’s teachers, for instance: “use many examples of many different sorts; go slowly; be receptive to questions and to students’ original thoughts; press for clarity; arrange for students to engage each other in discussion and challenge; arrange for them to assume progressively greater control over and responsibility for their learning; encourage students to be aware of what they are doing and review what they have done; ask for a focus and for reasons in any discussion, and encourage students to do likewise” (Pressceisen, 1987).

How to effectively teach critical thinking?

Maiorana (1992) stated that developing a thorough and practical methodology that includes the following principles will have great implications for teaching critical-thinking skills across the curriculum. Maiorana proposed several attributes of an effective, ideal methodology for teaching critical thinking. They are: (1) course content and critical thinking are to be taught simultaneously, (2) the subject matter, not the teacher, is the focal point of the classroom, (3) the students must become actively involved in manipulating the subject matter, (4) an ideal method works in all subject matter disciplines, (5) an ideal method works both in introductory courses and at advanced learning levels, (6) an ideal method works with all forms of educational technology, (7) an ideal method works outside of the classroom setting as well as within the classroom and (8) an ideal method provides a practical basis for assessing achievement. Kennedy et al. (1991) stated that there is general agreement in the
literature that teachers need to be trained in critical thinking dispositions and skills in order to be able to teach thinking effectively.

The challenge presented by the assessment of cognitive development and learning is that thinking processes and the qualities of learners' thinking and knowledge must be observed, not just their results or products. For example, it is not enough to know that learners have stored and can recall information. How their knowledge is organized and the degree to which it is integrated must also be determined (Johnson & Thomas, 1992).

Bloom's Taxonomy

Bloom's Taxonomy postulates the teacher's basic task in the classroom as the guidance of students in the acquisition of knowledge and the development of intellectual abilities and skills. Stahl (1989) stated that Bloom's Taxonomy has dominated instructional design and evaluation for a quarter of a century. The purpose of the Taxonomy was to develop a classification system that would enable educators and others to communicate more clearly about test items, educational objectives, and testing procedures (Martin & Briggs, 1986). Researchers have recognized Bloom's taxonomy as a reliable and valid tool that is used in analyzing and classifying cognitive behaviors (Furst, 1981).

What has finally come to be known as Bloom's Taxonomy of Educational Objectives is a system for stating educational objectives that requires a plan of purposeful specific activities, reduces vagueness, provides a set of common terms, and improves communication among educators (Covington & Tiballi, 1982). Bloom
(1956) stated that the taxonomy is designed to be a classification of the student behaviors, which represent the intended outcomes of the educational process. Based on Bloom’s Taxonomy, Martin & Briggs (1986) stated that the student behaviors were categorized into six major categories and within each category into specific subgroups. All categories were arranged hierarchically, from most simple to most complex. Bloom (1956) revealed that the attempt to arrange educational behaviors from simple to complex was based on the idea that a particular simple behavior may become integrated with other equally simple behaviors to form a more complex behavior. The learner’s task has been defined as a search for appropriate information and methods from previous experiences, which are brought to bear on new problem (Bloom, 1956).

Cowingtom & Tiballi (1982) stated that when using the taxonomy, educators could intelligently design course curriculum and follow through with tests measuring these outcomes because the specific level of mastery desired could be articulated. Fain & Bader (1983) stated that the achievement of educational objectives would be reflected in the behavior of the student, and that this behavior could be observed, described and eventually classified.

Bloom et al. (1956) described the categories as linear and cumulative. For example, to think at the analysis level, one must pass sequentially through and operate at the levels of knowledge, comprehension and application. The following are the six levels which form the Bloom hierarchy of educational objectives:
Knowledge:

The knowledge level is the lowest level in the hierarchy order which involves the ability to recall or recognize information. According to Bloom et al. (1956), the essential behavior elicited by the student is remembering. Question beginning with who, what, when and where are common in this categories.

Comprehension

The comprehension level refers to the students' ability to use previously acquired information to solve a novel problem (Fain & Bader, 1983). Bloom et al. (1956) stated that the level involves rephrasing information, rearranging or reordering of materials and extending information in accordance with the original details.

Application

The application level mainly involves the use of knowledge in specific concrete situations. The knowledge may be in the form of general ideas, rules of procedure or generalized methods (Okoro, 1993). Fain & Bader (1983) stated that unlike the comprehension level, where the test item or its context directs the students' attention to the applicable information, the application level's test item does not provide this clue. Thus, before students can solve the problem, they must determine the appropriate knowledge and recall it.

Analysis

The analysis level refers the student's ability to identify errors in communication (Fain & Bader, 1983). According to Bloom et al. (1956), the analysis level is meant to
clarify information through an understanding of the arrangement and organization of materials and how the materials communicate.

Synthesis

According to Fain & Bader (1983), the synthesis level refers to the student's ability to create an original verbal or nonverbal communication, such as: a short story, a speech or a poster. It can also involve the student's ability to create a procedure or plan for accomplishing a task. This level involves working with pieces, parts and elements, arranging and combining them in such a way as to form a pattern/structure that was not clearly evident to the learner previously (Bloom et al., 1956).

Evaluation

At this level, quantitative or qualitative judgments are made about materials or methods for a given purpose (Bloom et al., 1956). The evaluation level refers to the student's ability to judge the value of ideas as products (Fain & Bader, 1983).

Criticism of Bloom's Taxonomy

De Landsheere (1977) lists four criticisms of the Bloom's taxonomy:

(1) The taxonomy has real but limited validity because the criteria for classification are not the same across subcategories.

(2) There is lack of reliability across the categories due to the vagueness of the category descriptors.

(3) The taxonomy is of limited usefulness for curriculum development because it artificially separates content and thinking, and it separates substantive behavior and thinking.
(4) The taxonomy is weighted toward knowledge rather than the higher mental processes. In addition, it is impossible to use the taxonomy without reference to the specific background of the individual.

Martin & Briggs (1986) also proposed that the taxonomy has some definite weaknesses: the distinctions between the category classifications are neither clear nor sharp, they are not mutually exclusive, and the taxonomy is only minimally supported. However, De Landsheere (1977) stated that even if the taxonomy does nothing more than make teacher more aware of the enormous place factual knowledge takes in school learning and of the relatively low regard of higher cognitive processes, the time and effort devoted to its development and use are still exceedingly worthwhile and the criticism of it are of negligible importance. Although Bloom's taxonomy does not address teaching for critical thinking, it provides a basis for formulating instructional models aimed at developing critical-thinking skills (Maiorana, 1992).

The Newcomb/Trefz Classification

Newcomb and Trefz (1987) modified Bloom's Taxonomy of Educational Objectives. In their modification, Bloom's six levels are collapsed into four levels: remembering, processing, creating and evaluation. The remembering level is similar to the knowledge level; the processing level is a combination of the comprehension, application, and analysis levels. The creating level which is similar to Bloom's synthesis level is the next in the hierarchical order. The evaluating level in both classifications of educational objectives is the highest level of cognitive activity.
1. Remembering: involves no more than a recall of information presented to the student;

2. Processing: requires an understanding of the information and its use in a procedural manner;

3. Creating: requires the combination of information in a form that is new to the student;

4. Evaluating: requires the student to use the information in making an independent judgment or evaluation.

Newcomb & Trefz (1987) concluded:

1. Involvement of the faculty member who taught the course in jointly classifying the distribution of learning across the levels of cognition was workable and the project staff felt it produced a more accurate assessment than completing the assessment without the involvement of the professor.

2. Faculties were very interested in learning how to assess levels of cognition, in helping with the assessment, and in learning how to teach and test at the higher levels of cognition.

3. There were wide fluctuations in distribution of learning across the levels of cognition among individual faculty members.

4. There was more learning at the remembering level in lower division courses and more learning at the processing level in the upper division courses. There was limited learning at the creating and evaluating levels for either course division.
5. In both lower and upper division courses, when instructors include laboratories, homework, individual and group projects, and term papers, more learning was found at the higher levels of cognition.

Newcomb and Trefz (1987) found that professors of agriculture were more concerned about what their students learn, but less concerned about the cognitive level of instruction. They suggested that if instruction always occurs at the lower levels of cognition, then students would not have the ability of problem solving, analysis and evaluation.

Comparing the two taxonomies, Bloom's taxonomy and Newcomb and Trefz's taxonomy, the 'remembering' level was similar to the 'knowledge' level; the 'processing' level was similar to the combination of the 'comprehension, application, and analysis' levels; the 'creating' level was similar to the 'syntheses' level; and the 'evaluating' was similar to the 'evaluation' level (Figure 1).

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<thead>
<tr>
<th>Newcomb and Trefz's</th>
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<td>Creating</td>
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Figure 1: The comparison between Newcomb and Trefz’s Taxonomy and Bloom’s Taxonomy
The Florida Taxonomy of Cognitive Behavior (FTCB)

The Florida Taxonomy of Cognitive Behavior (FTCB) is a system used to classify instructional cognitive behavior (Webb, 1970). This system was derived from Bloom’s Taxonomy of Educational Objectives. When the two taxonomies are compared, it is noted that the Bloom’s taxonomy has six categories of cognitive behavior while the FTCB has seven categories which consist of: knowledge, translation, interpretation, application, analysis, synthesis and evaluation. Miller (1989) described the differences between the two as follows: the FTCB recognizes seven major levels of cognition rather than six as does Bloom et al. (1956). In the FTCB, the areas of Translation and Interpretation encompass Bloom et al.’s level termed Comprehension. The FTCB also recognizes aspects of the knowledge level of cognition, but considers them to be equivalent. The application, analysis, synthesis and evaluation levels are similar in both taxonomies (Figure 2).

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<th>Bloom’s Taxonomy</th>
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<td>Knowledge</td>
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Figure 2: The comparison between Bloom’s Taxonomy and FTCB
The FTCB is made up of fifty-five specific categories which are classified into seven levels of cognition. The following is a brief discussion of the levels of cognition in the hierarchical order:

The Knowledge Level

The knowledge level, which deals with the remembering ability, is similar to the lowest level, knowledge, of Bloom's Taxonomy.

The Translation Level

The translation level uses knowledge by either restating, giving concrete examples of abstract ideas of translating knowledge or information from one form to another (Dlamini, 1996).

The Interpretation Level

Dlamini (1996) stated that the interpretation level deals with an individual's understanding of relationships in communication. For example, when a person operates in this category, he/she can explain why a situation takes place, can show similarities or differences and can show cause and effect relationships.

The Application, Analysis, Synthesis and Evaluation Levels

The application, analysis, synthesis and evaluation levels in the FTCB are not different from the way they are presented in Bloom's taxonomy.
Barriers and suggestions to teach in higher cognitive level

Critical mass in developing web-based programs and services is achieved when the right combinations of faculty enthusiasm, technological infrastructure and administrative support lead to the recognition of pedagogical opportunities (Truman & Hartman, 1998). Truman & Hartman (1998) stated that faculty must be willing to experiment in developing successful web-based learning environments. Some factors that prevent faculty from pursuing technological innovations are: fear of change, fear of time involved, fear of appearing incompetent, fear of technology, fear of failure, not knowing where to start, fear of making bad choices, fear of typing and the fear of reprisals and rejection (Williams, 1996). Gall (1970) described the reason why teachers have emphasized using fact questions in the classroom for over a half-century is the lack of effective teacher training programs. Truman & Hartman (1998) stated that provision of adequate campus infrastructure ensures equipment, software and

<table>
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<th>Bloom's Taxonomy</th>
<th>FTCB</th>
<th>Newcomb-Trefz Model</th>
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<td>Knowledge</td>
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<td>Comprehension</td>
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production support to prevent faculty from feeling frustration if they have made a sincere commitment to teach on-line.

**Training**

Truman & Hartman (1998) found that facilitating the change in the shift in role as an on-line teacher leads to more student-centered, active learning. Faculty development programs that are collaborative and provide just in time learning prevent problems and increase satisfaction rates among faculty and eventually their students. Truman & Hartman (1998) also found that faculty must find the balance of their roles as facilitator and coach rather than pure subject matter expert and curriculum source.

**Pedagogical goals**

"Distance education is a planned learning experience that normally occurs in a different place from teaching and as a result requires special techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements" (Moore & Kersley, 1996). Distance education should consider psychological effects during the teaching and learning process. For effectively applying the teaching and learning principles in agricultural education, the difference between youth learners and adult learners should also be considered. Truman & Hartman (1998) described that course production is best done when the faculties have taken sufficient time to examine their pedagogical goals.

**Reflective Thinking**

In educational research today, educators are attempting to make students more reflective in their thinking rather than just encouraging them to give an opinion.
Jonassen (1995) defined reflective as: "Learners articulate what they have learned and reflect on the process and decisions that were entailed by the process." Researchers stated that reflective thinking requires an ability to recognize problems, gather pertinent information, interpret data, appraise evidence, and to evaluate lines of thinking, points of view, and personal insights that might contribute to the framing of logical, effective, reality-based action. "Reflective judgments are made by examining and evaluating relevant information, opinion, and available explanations (the process of reflective thinking), then constructing plausible solution for the problem at hand, acknowledging that the solution itself is open to further evaluation and scrutiny" (King & Kitchener, 1994). Engaging in reflective thinking helps people become better problem solvers (King & Kitchener, 1994).

Reflection seems to lie somewhere around the process of learning and the representation of that learning. Learners reflect on something in order to consider it in more detail (Moon, 1999). Another understanding of the word is that it involves complicated mental processing of issues for which there is no obvious solution (Dewey, 1933; King & Kitchener, 1994). Reflection appears to suggest more processing than simply recalling something (Moon, 1999).

**Reflection in learning**

Morgan (1993) stated that "learning is to take account of their experiences; to understand learning from the learner’s perspective and to adopt holistic approaches for our research into the student experience and our evaluation of it". He also stated that "the other aspect is to encourage the learners to become more aware of how they came
to be engaged in study, their own aims and aspirations, and to help them become more aware of her studying patterns in general” (Morgan, 1993). Boud, Keogh and Walker (1985, p19) described “reflection in the context of learning is the generic term for those intellectual and affective activities in which individuals engage to explore their experiences in order to lead to new understandings and appreciations.” According to Boud, Keogh and Walker, the essence of reflection is to explore experiences and move on to new understandings. Therefore, Morgan (1993) stated that learners needed to move to new understandings, at the same time as we scrutinize our teaching and learning practice.

Morgan (1993) stated that in distance education, the structure of the teaching and learning system, with a much greater separation of the teacher and learner, tends to favor transmission modes of teaching, through the specially prepared correspondence text. He also stated that the most important step that can be taken to improve student learning is to place existing practices in teaching and assessment under scrutiny. According to Morgan, “critical reflection” is a way of looking at the teaching and learning practice.

Boud, Keogh and Walker (1985) suggested that there are three key elements to the process of reflection:

(1) Returning to experience: is the activity of recalling;

(2) Getting back to whatever learning event we are concerned with: for example: exploring and removing feelings which obstruct further consideration of the learning experience;
(3) Re-evaluating experience: involves examining the experience in the light of the learners' intentions, exploring new knowledge relating this to existing knowledge and building up to the learners' existing conceptual framework.

Morgan (1993) stated that the notion of reflection in learning seems applicable to education and training in a wide range of contexts. For example, in an industrial training program, the learners were encouraged to continue working from the training program as the basis for reviewing their experiences in their new more senior position as supervisors. They worked with diaries to record experiences of learning in the workplace and how their formal learning related to the day-to-day demands of the jobs. So, through the process of reflection, they were able to become more aware of themselves in the organization and the constraints under which they had to operate. Reflection, after the experience, is an essential activity for becoming aware of the personal, political and social dimensions to the learning process (Morgan, 1993).

Stiles (1961) described the components or phases of reflective activity:

1. The presence (and recognition) of a problem situation;
2. Clarification of the problem;
3. Hypotheses formed, tested and modified. Hypotheses, which may also be called hunches, guesses, ideas or insights, lead to casting predictive statements in the form of "if-then" propositions. Such hypothetical propositions account for or
explain the facts already observed or stumbled upon and, in addition, serve to direct further observation or fact finding;

(4) Action taken on the basis of the best-supported hypothesis.

Stiles (1961) stated that the four phases seem to correspond fairly well with the analyses of reflective thinking made by other persons who have investigated the matter. Hoover (1984) stated that “reflective thinking which allows us to adapt when faced with the problematic – a method of effectively moving from the unsettled to the settled where the settlement is sufficient.” Brown’s (1998) stated that “articulating ideas in group discussion, debate, and activities offers learners opportunities to reflect about their past knowledge and experiences, and their interests in and purposes for learning” (p44).

**Using verbal report to assess students' reflective thinking**

School assessment too often ignores the process of individual’s cognitions. Cano & Newcomb (1990) stated that if students are limited to repeating back to the teacher that which was given to them, then not much learning could endure; if not much learning occurs at the higher levels of cognition, students would not have sufficient abilities at operating at the higher level of cognition, such as: analysis, synthesis and evaluation. A valid appraisal of teaching must be anchored to what happens to the individual student because, in essence, teaching is the interaction between the instructor and the learner (Ericksen, 1984). Underbakke, Borg & Peterson (1993) stated that higher order thinking is when a person can combine information in
memory with new information to achieve a purpose such as to solve a problem, analyze an argument, negotiate issues or make a prediction. There is evidence that professors are not satisfied with teaching at the lower cognitive levels (Whittington & Newcomb, 1992). Ericksen (1984) stated that the prime responsibility of the teacher is to help students advance from dependent memorizing to independent thinking, problem solving, critical thinking, decision making; i.e., higher level cognition.

According to the previous studies, researchers' interests in studying the cognitive processes involved in reading have recently shown interest in the use of verbal reports to gather data on aspects of the reading process. Verbal reporting had been an important component of psychological investigation, including reading research, prior to the rise of behaviorism. The verbal reporting task requires subjects to allocate attention to both processing and reporting of the processes. The more explicit that subjects make their reports then the more reliable will be the classifications of these processes because the researchers will need to make fewer inferences (Afflerbach & Johnston, 1984).

Think-aloud protocol

The thinking protocol was first applied in reading research. Think-aloud is one type of verbal reporting method in which the researcher provides a task and asks subjects to say aloud everything that comes to mind as they are performing it (Wade, 1990). Randall, Fairbanks & Kennedy (1986) stated that thinking-aloud protocols are powerful diagnostic tools that teachers and clinicians can use to collect valuable information about the interactive nature of the reading process. When readers do not
interact successfully with texts, they fail to build meaning and poor comprehension results. To help students who have difficulty interacting with texts, teachers should examine the nature of reader-text transactions, ascertain the causes of comprehension failure and provide guidance in use of strategies for successful reader-text interaction (Randall et al., 1986). Davey (1983) stated that the activities teachers used to verbalize students' thoughts while reading orally was called “think-alouds,” which can help poor readers clarify their views of reading and their use of strategies. Wade (1990) stated that think-alouds was readers’ verbal self-reports about their thinking processes. Data of verbal reports are an important source of information about cognitive processes that could not be investigated directly; moreover, verbal reports also allow access to the reasoning underlying cognitive behaviors (Afflerbach & Johnston, 1984; Brown, 1987; Ericsson & Simon, 1980; Garner, 1987; Genest & Turk, 1981).

Meyers et al. (1990) stated that think-aloud protocol analysis is a procedure that can be used to assess the moves and strategies used in reading comprehension. To probe verbally the readers’ internal state is one method which is frequently used to gain information about the course and mechanisms of cognitive processes (Ericsson & Simon, 1980). Ericsson & Simon also stated that when verbal reports are collected concurrently with other records of behavior, it becomes possible to check the consistency if the reports with the other behavior. “Verbal report, elicited with care and interpreted with full understanding of the circumstances under which they were obtained, is a valuable and thoroughly reliable source of information about cognitive processes” (Ericsson & Simon, 1980, p 247).
Think-aloud is about how you would plan for reading and studying the material. It not only demonstrates how to read but also why and when you would use certain strategies. For instance: some readers may survey the headings to get an overall idea before reading the content (Davey, 1983). Metacognitive theory provides a conceptual frame of reference for think-aloud protocol analysis (Brown, 1980; Meyers, 1988). Metacognitive theory suggested that the individual’s knowledge of his or her own cognitive processes may be a critical component of the learning process and that instruction can be facilitated by increasing the reader’s awareness of his or her own learning strategies (Brown, 1980; Meyers, 1988). Meyers et al. (1990) stated that this approach is based on “moves” and “strategies”. “Moves” refer to the responses that reflect what the reader is doing at a particular point in time to understand what he/she is reading and “strategies” refer to the patterns of moves utilized to solve a particular problem with comprehension. A debate exists about the validity of data derived from verbal reports such as think-aloud protocols regarding whether verbal reports actually reflect the subject’s thought processes (Afflerbach & Johnston, 1984; Ericsson & Simon 1980). However, Meyers et al. (1990) stated that the think-aloud protocol approach has been used with a variety of tasks to demonstrate that cognitive strategies can play an important role in academic learning (Bereiter & Bird, 1985; Lytle, 1982), mathematics (Brueckner, 1930; Kruteskii, 1976; Lankford, 1974), and in general problem-solving situations (Ericsson & Simon, 1980).
Procedures and analysis of the think-aloud protocol

Wade (1990) described the procedure of conducting a think-aloud task: “passages should be selected or written so that readers cannot know for sure what the topic is until they have read the last segment. Thus, readers are required to generate hypotheses during their think alouds about the text’s meaning from clues in each text segment. The procedure ends with the reader retelling the whole passage in his or her own words” (p444). Wade (1990) also presented a table to describe the procedure for administering and scoring a comprehension think aloud that is divided into three sections:

1. Preparing the text
2. Administratering the think aloud procedure, and
3. Analyzing results (Appendix B).

Afflerbach & Johnston (1984) stated that students were asked to report on the processes in a think-aloud task; however, theorizing about the reports was left to the researcher. Thus, based on Afflerbach & Johnston’s (1984) statement, some factors exist that the researchers should take into consideration when conducting the think-aloud task:

1. Probing: Probing has been an important component of many verbal reporting studies. Many researchers have included probes in their experiments, using them to minimize data loss by prompting the subject to maintain enough space for the reporting task. The probes have the effect of increasing the explicitness of the reports and, hence, the reliability of the reports (Afflerbach & Johnston, 1984).
(2) Subjects: Afflerbach & Johnston (1984) stated that the selection of subjects for verbal reporting tasks requires consideration of the objectives of the research, the task to be performed, and knowledge of the potential problems that may be encountered due to the uniqueness of the verbal reporting task. They also pointed out that there is a trade-off of internal for external validity: if one chooses subjects that may be most able to provide rich protocols, one should also be aware of the bias which is part of such research designs.

(3) Analysis: Previous research using verbal reporting has found that subjects exhibit individual differences and commonalities in their reported cognitive processes (Brown & Day, 1983; Chi, Glaser, & Rees, 1982; Garner, 1982; Johnston & Afflerbach, 1983). In order to characterize the similarity and differences between individuals' cognitive strategies, developing response classification schemes is necessary (Afflerbach & Johnston, 1984). Randall et al. (1986) proposed a useful system of categorization to analyze the reports of think-aloud protocol.

![Diagram](image-url)

Figure 4. Randall et al. (1986)'s categorization of analyzing the think-aloud protocol reports
In order to make the results less sensitive to individual differences in this study, the researcher adapted Randall et al. (1986) classification to categorize students' think-aloud responses and adapted Newcomb and Trefz's taxonomy (1987) to identify students' reflective thinking levels of cognition.

![Diagram of modified Randall et al. (1986) and Newcomb and Trefz's categorization of analyzing the think-aloud protocol reports]

**Figure 5.** Modified Randall et al., (1986) and Newcomb and Trefz's categorization of analyzing the think-aloud protocol reports

(4) Research design

Many verbal report studies have used relatively small numbers of subjects. There are obvious reasons for this. The amount of time needed to transcribe and analyze protocol contents may be a concern for researchers considering using verbal reports (Afflerbach & Johnston, 1984). Another concern for researchers when using think-aloud protocol might be the verbal report validity. Since cognitive processes are
not directly observable, they must be inferred from available data. Some researchers suggested to use multiple indicators, such as: eye movement as potentially important indicators; however, in web-based education, many students’ behaviors can not be observed other than their own verbal reporting.

**Hand written protocol**

Meyers et al. (1990) stated that evidence was presented in support of the use of hand written protocols. Although researchers have often used tape recordings to gather think-aloud protocols, hand written protocols have been shown to correspond closely with protocols derived from tape recordings. Hand written reports are also more practical than tape-reordered protocols, which would be more time consuming for practitioners to code. Meyers et al. (1990) emphasized that the hand written procedure also eliminates the errors that occur during transcription of audio tapes that are difficult to hear. They suggested that future research be designed to determine whether these methods have reactive effects on subject’s production of think-aloud protocols.

**Web-based education**

After the advent of computer technology, many educators expected that computers would help teachers and learners to achieve better outcomes in the teaching and learning process. On the one hand, they used computers to help provide greater variety in the learning process. On-line learning with computers could also help educators to overcome distance. The Internet made distance education more effective. Lippert (1998) reported that one of the most recent forms of distance education to be explored is interactive instruction exclusively via the Internet. This type of instruction
is now possible in many areas because of the widespread availability of computers and Internet technology.

According to Moore & Thompson (1990), distance education has existed since the late nineteenth century and initially was used in foreign countries. The evolution of distance education in the United States can be traced to correspondence courses used by corporations, the military, and universities. In the beginning, there was the word—the printed word. In this earliest form, distance education meant study by correspondence. As new technologies developed, distance instruction was delivered through such media as audiotape, videotape, radio and television broadcasting, and satellite transmission. Microcomputers, the Internet, and the World Wide Web (WWW) are shaping the current generation of distance learning, and virtual reality, artificial intelligence, and knowledge systems may be next (Kerka, 1996).

A number of studies have examined the demands of distance education on teachers when using the Internet. For instance, Swortzel & McCaslin (1995) found that educators are already utilizing some applications of the Internet. For example, electronic mail (e-mail), electronic bulletin boards, and discussion groups have been used by agricultural educators. These applications have allowed individuals to communicate important information, such as meeting dates and lesson plans, with each other. They also have helped educators save time and money by getting information quickly and efficiently. Lippert et al. (1998) reported that distance learning has become a popular method of instruction, especially for students with demanding, full-time jobs or who find it difficult to invest a lot of time and expense in travel.
On-line learning — Internet

Many studies have pointed out the advantages of Internet distance education. Internet courses provided the following advantages. First, they can allow for constant personal interaction between the student and instructors. Second, they can allow much greater time flexibility than televised real-time instruction where students must meet at a designated facility for scheduled instruction. Finally, they expand resource opportunities through access to the Internet and the potential to communicate with special lists throughout the World. Lippert et al. (1998) explained that Internet education eliminates the need to travel to another location in a state or region; thus, saving time and money.

Positive opinions of distance education

Smith and Stroud (1982) described distance education as the most significant development in education since World War II. Agricultural educators have only recently become interested in distance education, but the level of interest is increasing at a rapid pace (Miller, 1994). Several recent studies investigated the effectiveness of distance education. In a study of computer-aided learning using the WWW, Goldberg (1996) found that students who were taught using traditional lecture and the WWW performed better than two other groups who were taught with either traditional lecture or the WWW. Day (1998) reported that students who were taught using the WWW with a laboratory achieved at a higher level than students who were taught using the traditional classroom approach. Off-campus degree programs are becoming more common as universities recognize the need to extend educational opportunities beyond
the campus to adults who are unable to pursue degrees through traditional means. Off-campus degree programs fit well within the mission of Land-grant University and colleges of agriculture (Miller, 1995).

**Negative opinions of distance education**

A small number of studies have not found positive results on students' learning from distance education. Kerka (1996) noted that learning at a distance can be both isolating and highly interactive. Lack of nonverbal cues can create misunderstanding, but communication protocols can be established and relationships among learners developed. A common stereotype is “the loneliness’ of the long distance learner” (Eastmond, 1995). As for the learning effectiveness of distance education, Filipczak (1996) noted that distance learning (DL) on the Internet can be cheaper, faster, and usually more efficient than other learning modes, but not necessarily more effective.

More emphasis in distance education has been placed on the feedback from teachers. Nehiley (1998) demonstrated that one problem was grading the papers. The average hard copy could be graded in five minutes. The electronic test version required about twice as much time and the Internet students complained that they could not find the comments. For those misspelled words, write comments like "not part of this subject", or to comment “passive voice”, “subject/verb disagreement”! With the Internet papers, the cursor had to be inserted with comments that the students could find and understand.

While these studies have various perspectives of distance education, little research has been conducted to determine: as a teaching and learning method, does
distance education effectively utilize teaching and learning principles? An important notion, which was proposed by Miller (1994), was that if the separation or distance is removed, distance education closely resembles “traditional” education. According to this notion, researchers should examine the teaching and learning process of distance education, such as with traditional education, to see if it successfully employs teaching and learning principles.

**Psychological Foundations of Teaching and Learning Principles — Applied in distance education**

Rosenshine & Furst (1971) conducted a meta-analysis and identified the five strongest variables of teachers’ behaviors, which could affect the outcome of teaching and learning. Newcomb, McCracken & Warmbrod (1993) proposed principles of teaching and learning to improve teaching and learning in agricultural education. Miller (1999) synthesize the teaching and learning principles and five variables of teachers’ behavior as six aspects: (1) initiating and maintaining interest, (2) stimulating student thinking, (3) use of instructional tools, (4) classroom management and interpersonal relationships, (5) application and practice, and (6) activities and characteristics throughout the teaching-learning process.

Cognitive behavior means the individuals’ responses to the flow of information coming to them through their senses, how they select from the flow those items to which they pay attention, how they apply meaning to it and how they manipulate it. Cognitive theorists insist that individuals do not merely “respond” but that they react to and organize the information which comes to them and that it is in this shaping of the
environmental stimuli that one finds the most significant fact for learning (Miller, 1964).

Cognitive theory deals with the problem of how people gain an understanding of themselves and their environments, and how people act in relation to their environment by using their cognition. As a result, in order to improve the learning outcomes of students, teachers need to have a basic understanding of the psychological reaction during the teaching and learning process. In this study, the researcher will examine the psychological foundation of the teaching and learning principles and apply them to the distance education.

**Motivation**

In Newcomb, McCracken & Warmbrod's teaching and learning principles (1986), five principles are related to the important psychological factor of motivation.

1. Learners must be motivated to learn. Learning activities should be provided that take into account the wants, needs interests and aspirations of the learners.

2. Learners are motivated through their involvement in setting goals and planning learning activities.

3. Success is a strong motivational force.

4. Learners are motivated when they attempt tasks that fall in a range of challenge, such that success is perceived to be possible, but not certain.

5. To maximize learning, learners should “inquire into,” rather than be “instructed in,” the subject matter. The problem-oriented approach to teaching improves learning.

**Psychological foundation**
An interesting approach to motivation is McClelland's (1961) theory of motive acquisition, which he refers to simply as the "need to achieve." In effect, the theory says that, when individuals are with a group of people who place a high value on getting ahead, they will feel strong pressure to "conform" in order to be like the others, and hence they will begin to put a higher value on achievement and hard work (Mueller, 1974).

If learning is defined as a permanent change in behavior as a result of experience, then motivation is the study of the activation or arousal of behavior, its strength and direction (Cross, 1974). Obviously, motivation plays a critical role in learning. Students who are motivated work purposefully and energetically (Bigge & Hunt, 1968).

The teacher's motivational functions are: (1) to engage the student in learning, (2) to describe concretely for the students what they will be able to do at the conclusion of the instruction, (3) to provide rewards for present achievement in a way which stimulates future achievement and (4) to use rewards and punishment to control deviant behavior (De Cecco, 1968).

Adults intend to apply immediately what they learn, whereas youth intend to postpone application of most of their learning. As a result, youth approach learning in a subject-centered frame of mind, while the adult brings a problem-solving frame of mind (Knowles, 1969). Mature people learn best in educational situations where the students and teacher have a relationship of mature responsibility or diagnosing learning needs, formulating objectives, and planning, conducting and evaluating learning
experiences (Knowles, 1969). The adults learn best through methods and techniques that use their experiences (Knowles, 1969).

**Applied in distance education**

Baker (1995) described that all students desired high quality interaction with the distance education technology. This finding reinforces the often stated belief that the key to success in distance learning is the teacher. “If the teacher on the system is good, the technology itself can become almost transparent. Conversely, no technology can overcome poor teaching; poor teaching is actually exacerbated in distance education applications” (Baker, 1995).

In the traditional classroom, teachers should ask questions to help students think and engage in the learning situation. Teachers could do so when they use distance education, however, the process sometimes could be interrupted by the environment, such as: a power failure, the equipment being out-of-order or students who can not operate it well. As a result, Hillman, et al. (1994) recommended that all students planning to take a course via distance education be required to first take a technology-based class. Although this may not be feasible, educators must make efforts to improve their students’ interaction with distance education technology so it does not overshadow the learning experience. Saba (1999) suggested that a help desk should be provided for students to respond to their technical problems.

To help learners make effective use of distance learning methods, skilled facilitation is essential. Rohfeld and Hiemstra (1995) suggested ways to overcome the challenges of the electronic classroom: (1) establish the tone early in the course; (2) to
overcome the text-based nature of online discussion and to build group rapport and cohesion, introduce participants to each other, match them with partners, and assign group projects; (3) offer training and guidelines to help learners acquire technical competence and manage discussions; (4) provide a variety of activities, such as debates, polling, reflection, and critique; and (5) use learning contracts to establish goals for participation (Kerka, 1998).

Readiness

Readiness is a prerequisite for learning. Subject matter and learning experience must be provided that begin where the learner is (Newcomb et al., 1986).

Psychological foundation

Bigge & Hunt (1968) proposed that some persons are never ready for certain learning tasks which are assigned by teachers, even at the minimum standards set by teachers. The teaching and learning process occurring under conditions for which the students are not ready might result from poor coordination, poor vision, lack of previous experience and negative mind-set. Education can only assume that, when a person is ready for new learning, it is because they have developed their ability and interests to the point that they see the new learning as the next step for them to make.

Applied in distance education

In the teaching and learning process, teachers have to initiate and maintain the interest of students by meeting their needs, wants and interests. Saba (1999) proposed that in distance education, strategic planning is not an option but a necessity. The planning process can be summarized in a five-step model: (1) analyzing the needs of
the learner, (2) designing instruction based on students' learning needs, (3) developing instructional materials, (4) implementing instructional sessions, and (5) evaluating the results systematically.

**Clarity**

When the subject matter to be learned possesses meaning, organization, and structure that is clear to learners, learning proceeds more rapidly and is retained longer (Newcomb et al., 1986). Rosenshine & Furst (1971) also considered that clarity as a critical factor which will influence students’ learning.

**Psychological foundation**

Positive relationships between ratings on the behavior labeled “organization” and regression-adjusted student achievement scores were obtained in all the studies mentioned (Rosenshine & Furst, 1971). Material which is meaningful to students is remembered much better than materials which is not. Meaningfulness consists of relations between facts -- generalizations, rules, and principles. Solitary facts essentially are on the same level of meaninglessness (Bigge & Hunt, 1968). Vygotsky believed that linguistic relativity and determinism highlight the importance of language as a key process for education. The language which learners use influences their thinking and the way they see the world. Teachers have a primary function of expanding and developing learners’ language; whatever age and whatever subject they teach. While Vygotsky believed that it is the gradual internalization of speech that leads to the development of thinking, Piaget took a different view. He believed that children’s development of thinking depends on their acting on their environment.
Language may be involved to amplify or facilitate thinking, but is not essential for thinking (Fox, 1993).

Bruner considered the purpose of teaching as the development of thinking rather than acquiring knowledge in terms of facts. Learners can not learn all the facts and information that are presently available. What is important is that they develop structures to understand, integrate and transfer knowledge. He described how discovery learning helped learners to learn knowledge in such a way that they will transfer it to new situations to solve problems. Discovery learning involves an internal recognition and reorganization of previously known ideas. Asking questions about new information and then working out provisional ways of making sense of it is also involved in discovery learning. The discovery process allows the learners to take some control over the contents of the lesson and to discover new ideas and concepts. According to Bruner’s discovery learning theory, the teacher can then gradually increase the learners' knowledge and understanding through the development of more complex representations (Fox, 1993).

**Applied in distance education**

Rosenshine & Furst (1971) synthesized different descriptions of clarity: (1) clarity of presentation, (2) the points that the teacher made were clear and easy to understand, (3) the teacher was able to explain concepts clearly and (4) whether the cognitive level of the teacher’s lesson appeared to be “just right most of the time”.

According to the descriptions, distance courses can be as clear and organized as traditional classroom teaching. However, when the teaching process is unclear,
students in a traditional classroom can ask questions immediately while students in distance education often can not ask or communicate with teachers immediately.

Hiel & Herrington (1997) recommended that distance education efforts should be learner focused, with teachers providing an environment for interactive learning. To anticipate students' actions and reactions is a little difficult in distance education. To improve communication between teachers and students in distance education, Saba (1999) proposed that students should also have access to the instructor via e-mail or phone in case they encountered difficulty in understanding course materials.

**Variability**

Rosenshine & Furst (1971) considered variability as an important characteristic when teachers teach. Newcomb et al. (1986) stated that directed leaning is more effective than undirected learning.

**Psychological foundation**

In Piaget's cognitive structure, cognition plays an important role in motivation, readiness, clarity and variability. Cognitive development is a series of stages that are linked to the pupil's biological development. As each stage unfolds, the pupil is able to understand a more complex view of the world. There are essentially four states, named the dominant cognitive structure of each: (1) sensori-motor (age 0-2) innate reflex actions, (2) pre-operational stage (age 2-7): able to represent concrete object in a sentence and words, (3) concrete operational (age 7-11) stage: understanding of concepts and relationship ideas, and (4) formal operations (age 11 plus) stage: an ability to reason hypothetically, logically and systematically. Piaget believed that these
stages are biologically determined and are more or less age-related. He recognized that cultural and environmental factors lead to variations in the rate of development (Fox, 1993).

Piaget developed some principles for teachers: (1) new ideas and knowledge should be presented at a level consistent with the learners’ present state of thinking, (2) teaching should be matched to the needs of individuals, (3) pupils must have the opportunity to experiment actively with concrete materials in order to develop their thinking skills, (4) pupils learn by social interaction, and (5) they need to learn how to find out for themselves and to be able to verify what is true rather than being told how, or what, to think (Fox, 1993). Knowles claimed that adults learned differently than children: (1) the purpose of education for the young must shift from focusing primarily on the transmission of knowledge to the development of the capacity to learn, (2) the role of the teacher must be re-defined from one who primarily transmit knowledge to one who primarily helps students to inquire, (3) the curriculum of education for the young must shift from a subject mastery basis to a learning skill basis of organization and (4) a new set of criteria must be applied to determine the readiness of youth to leave full-time schooling (Jarvis, 1990).

Applied in distance education

Agricultural professors will no longer be able to rely solely on bulletins, journals, and textbooks to solve problems. Rather, they will need to be able to draw from a larger resource pool, communicate with other specialists, share resources and transmit information (Gunsett, 1993). Electronic networks will help learners
accomplish all of these tasks, quickly and efficiently (Murphy, 1994). On-line education has many ways to provide information; however, there are not many instructional tools to use. Teachers typically use the computer screen to do the lecture. Use of a single media lacks variability, one of Rosenshine & Furst factors distinguishing effective from ineffective teachers. As a result, there are some techniques that teachers can vary (Miller, 1998):

- **Groupings:** Large, small and individualize
- **Modality:** Use senses, such as: sight, hearing, touch, smell and taste
- **Study skills:** Opportunities to apply reading, writing, observing, listening, speaking, collecting, memorizing, practicing, problem solving…etc.
- **Assignments:** In class and outside; supervised and independent; paper and pencil and applied.
- **Level of Conceptual Skill:** Develop their abilities as critical thinkers, problem solvers and persons who operate at higher levels of cognition.
- **Roles:** Set up activities where students learn from you, learn from peers, teach peers, teach you and function as a team member.

**Practice**

Two of the teaching and learning principles relate to practice. First, learners learn what they practice. Second, supervised practice that is most effective occurs in functional educational experiences.
Psychological foundation

Sometimes learners get the point in a flash, like: learn to swim, learn to ride a bicycle; however, other learning requires lengthy practice. According to Thorndike, practice is not doing the same thing over and over. Practice refers to trials which have an experimental character; that is, trials in which the action is varied, even though slightly, and each time the learners ask themselves either verbally or nonverbally, “What does it feel like?” “What did I do wrong?” or “How can I do it better?” Practice is relevant to motivation. If learners have enough motivation, physical fatigue does not interfere seriously with learning. On the contrary, the absence of motivation will make a simple learning task hard to achieve (Bigge & Hunt, 1968).

Practice will improve a skill, and experience will help one’s competence -- but only if there is feedback regarding the quality of the performance. If you do not find out how well you are doing while you are practicing or experiencing, your skill is not likely to improve (Mager, 1984). That is one reason why supervised practice is effective. Teachers can give immediate feedback about students’ practice; as a result, students may know how well they have done through the practicing.

Applied in distance education

Mature persons confront a set of developmental tasks differently than youth; the adults’ developmental tasks concern performance in the changing roles of worker, spouse, parent and responsible citizen. Mature persons learn best in a curriculum sequenced to coincide with their developmental tasks (Knowles, 1969).
Reward

Newcomb et al. (1986) proposed that behaviors that are reinforced (rewarded) are more likely to be learned. They also mentioned the timing of the reward: to be most effective, reward (reinforcement) must follow as immediately as possible the desired behavior and be clearly connected with that behavior by the learner.

Psychological foundation

Several conditions of reinforcement influence the strength of the response or the adequacy of the performance: (1) the immediacy of the reinforce, (2) the frequency of the reinforcement, (3) the amount of the reinforce, and (4) the number of reinforces (De Cecco, 1968). Rewards are positive reinforcement; they are anything a teacher can do to encourage pupils to behave in a certain way. Rewards lead to an increase in desired behavior (Fox, 1993).

Reinforcement may result from the occurrence of positive reinforcement or from the termination of negative reinforcement. Thus, education can increase a person's motivation to repeat a particular act by following it either with a positive reinforcement or with the removal of an obnoxious condition (Mueller, 1974). However, behaviorists do not advocate using punishment to change behavior. Skinner (1971) describes a number of reasons why punishment does not work. If a teacher uses punishment, the students may learn how to behave appropriately in order not to be punished, but the process has a number of other possible effects:

- They may learn not to do the things at school and do them instead in other places.
- It does not teach the pupil an alternative way to act.
• It creates feelings of bitterness, tension and stress between the pupils and the teacher.

• It may have no effect because the pupil is also being rewarded for the behavior by his peers.

Because of these difficulties with using punishments, rewards are the most effective way of affecting pupils’ behavior. (Fox, 1993). Mueller (1974) also stated:” from research evidence it is safe to generalize that positive reinforcement is much more effective than negative reinforcement “. An important factor in behavior modification is time. For reward to be effective, they must occur immediately. Furthermore, it is important to correct a deviant behavior as early as possible, since any delay can cause it to become firmly established (Mueller, 1974).

According to Skinner, reinforcement occurs under a variety of circumstance: (1) as soon as a listener understands what a speaker is communicating and signifies this by a gesture or doing what is requested, (2) in the process of thinking by engaging in sub-vocal activity and (3) in physically writing down words or sentences on paper (Cross, 1974). Skinner (1953) recognized the significance of operant behavior and investigated it first in rats and pigeons and later in children to demonstrate principles of programmed learning. Instrumental conditioning has been likened to a practice known to animal trainers in circuses for centuries; namely follow a successful performance with an immediate reward (Cross, 1974).
Applied in distance education

Compared to the students in the typical classroom, the papers received from the Internet students were less complete and more disorganized. In addition, they followed the assigned format less carefully and were judged as being less successful by the professor (Nehiley, 1998). Distance education not only can support much variability in instructional tools, but also lack good classroom management and interpersonal relationships. Students' behavior can not get immediately reward and the teacher can not use non-verbal expressions to reinforce desirable student behavior. As a result, Nehiley (1998) suggested that perhaps a chat room, which would allow the students to ask more questions and then share their opinions, would reduce their reticence and result in papers more like those of the individuals in the classroom situations.
Summary

The development of cognitive instruction, critical thinking, higher level of thinking and problem solving ability have been of great concern in the recent past. A long-standing debate in U.S. education is whether schools should direct their efforts to teaching students how to think, rather than what to think (Bruning et al., 1999).

Bloom's Taxonomy postulates that the teachers' basic task in the classroom is to guide students in the acquisition of knowledge and the development of intellectual abilities and skills. Newcomb and Trefz modified Bloom's Taxonomy of Educational Objectives. In their modification, Bloom's six levels are reduced to four levels: remembering, processing, creating and evaluation. The Florida Taxonomy of Cognitive Behavior (FTCB) is a system used to classify instructional cognitive behavior (Webb, 1970). This system was derived from Bloom's Taxonomy of Educational Objectives.

<table>
<thead>
<tr>
<th>Bloom's Taxonomy</th>
<th>FTCB</th>
<th>Newcomb-Trefz Model</th>
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</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Knowledge</td>
<td>Remembering</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Translation</td>
<td>Processing</td>
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<td>Interpretation</td>
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<td>Application</td>
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<tr>
<td>Analysis</td>
<td>Analysis</td>
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<tr>
<td>Synthesis</td>
<td>Synthesis</td>
<td>Creating</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Evaluation</td>
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</tbody>
</table>

Figure 6: The comparison between Bloom's Taxonomy, The Florida Taxonomy of Cognitive Behavior (FTCB) and The Newcomb- Trefz Model
According to the literature about distance learning, Brown (1998) stated that technology can facilitate the collaboration process by linking individuals who have a same interest and goal. World Wide Web environments enabled learners to interact more with what they need to learn and to “create new relationships with knowledge and new representations of knowledge” (Conceicao-Rullee and Daley, 1998, p.41). Kerka (1996) also stated that the on-line distance education promotes peer learning by bringing learners together in the same space so that they can share their knowledge and insights. Web-based distance education has been expected to perform its educational role more efficiently and effectively than traditional education.

Based on the cognitive education literature, a successful distance education program should be able to provide high quality instruction. One way to examine the quality of instruction would be to assess the cognitive levels of the web-based distance education program. Therefore, this study sought to describe the levels of cognition of the teaching materials, describe the levels of cognition of students' reflective thinking of the teaching materials and compare the levels of cognition of the teaching materials and levels of cognition of students' reflective thinking. Through the study of the web-based course, the intention of the researcher is to gain insights that will suggest ways to help the pedagogical development of other web-based or web-enhanced courses.
CHAPTER 3

PROCEDURES

The purpose of this study was to describe the cognitive level of instruction of a selected web-enhanced course and to describe the cognitive level of students' reflective thinking in the course, which was offered at The Ohio State University. The procedures were explained in this chapter.

Research Design

This was a descriptive study. Relevant instruments were used in order to accomplish the following objectives:

1. To describe the levels of cognition of the teaching materials of a selected web-enhanced course.

2. To describe the levels of cognition of students’ reflective thinking of the teaching materials.

3. To compare the levels of cognition of the teaching materials and levels of cognition of students' reflective thinking.
Teaching materials (Instruction)

Population and Sample

The target population for the study consisted of a selected web-enhanced course at OSU. Due to practical limitations of time, money and professor's agreement to participate, one sample course was selected purposively. Fraenkel & Wallen (1990) stated that purposive sampling is: "based on previous knowledge of a population, and the specific purpose of the research, researchers use personal judgment to select a sample. Researchers assume they can use their knowledge of the population to judge whether or not a particular sample will be representative" (p.75).

Although the study can not make unbiased inferences to populations and the generalization of the results would be limited, this study emphasized to optimize understanding of the case rather than generalization beyond (Stake, 1998). The external validity of this study may be limited; however, what the researcher would like to generalize to would be theories rather than population. Such studies are of value in refining theories and suggesting complexities for further investigation, as well as helping to establish the limits of generalizability (Stake, 1998).

Instrumentation

Measuring cognitive level of instruction

In this study, the modified version of Newcomb and Trefz's taxonomy was used to assess the level of cognition of teaching materials of the web-enhanced course. Newcomb and Trefz (1987) developed a modified version of the taxonomy, which
included four specific levels:

1. Remembering
2. Processing
3. Creating
4. Evaluating

The researcher adopted Newcomb and Trefz’s taxonomy to identify the actual levels of cognition of instruction of the teaching material on the web pages. The researcher observed every web page and wrote down the actual levels of cognition of instruction delivered.

Validity

The validity of the classification system, which was developed by Newcomb and Trefz (1987), was based on the fact that it was derived from Bloom’s Taxonomy of Educational Objectives: Cognitive Domain (Miller, 1989; Whittington, 1991; Chen, 1994 and Dlamini, 1996). Since Bloom’s Taxonomy has been used widely by researchers to assess cognition, the classification system developed by Newcomb and Trefz is also considered valid.

Reliability

Reliability of the instrument was based on the rater’s utilization of the instrument. By using the Newcomb and Trefz’s classification system, teachers’ cognitive level of instruction were observed and assessed as soon as the teaching materials were completely posted on the web. After one week, the researcher observed and assessed the same teaching materials again. An intra-rater reliability
(r = .88) was calculated by computing the percent of agreement upon the two ratings of the same teaching materials.

**Data Collection**

Spring quarter in 2001 was selected as the period to collect the data at The Ohio State University. Data collecting focused on the main objective: “assessing the cognitive level of instruction on the selected web-enhanced course”. The researcher observed the instruction both in the classroom and on-line of the selected sample course. By using the Newcomb and Trefz’s classification system, teachers’ cognitive level of instruction were observed and assessed every week as soon as the teaching materials were completely posted on the web.

Based on the comparison table between Bloom’s Taxonomy, the Florida Taxonomy of Cognitive Behavior (FTCB) and The Newcomb- Trefz Model (Figure 4). The modified Florida Taxonomy of Cognitive Behavior instrument (Appendix A) was used to help to identify the cognitive level attained of the teaching materials.

Examples of observable verbs at each level of Newcomb and Trefz’s (1987) taxonomy include: “gives steps of process, describe method” (remembering level); “summarizes or concludes from observation of evidence” (processing level); “reorganize ideas, materials and processes” (creating level) and “evaluates something from evidence” (evaluating level).
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<td>Evaluation</td>
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Figure 7. The comparison between Bloom’s Taxonomy, The Florida Taxonomy of Cognitive Behavior (FTCB) and The Newcomb-Trefz Model

**Data Analysis**

After the cognitive levels of instruction were identified, the frequency distribution of the level of cognition of instruction attained in the web-enhanced course was used to analyze data. Frequency of level of cognitive instruction attained across all cognitive levels was totaled. The percentage of level of cognitive instruction attained at each cognitive level was calculated (Table 1).

<table>
<thead>
<tr>
<th>Level of cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
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<tbody>
<tr>
<td>1. Remembering</td>
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<td>2. Processing</td>
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<tr>
<td>3. Creating</td>
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<td>4. Evaluating</td>
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<tr>
<td>Total</td>
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Table 1. Frequency distribution of the level of cognition of teaching materials attained
Students' reflective thinking

Population and Sample

The population of this study consisted of thirteen graduate students who were enrolled in the selected web-enhanced course at OSU during the Spring Quarter of 2001. According to Fraenkel & Wallen (1990)'s statements of sampling in observational studies, the critical concern when doing sampling would be “to ensure that researchers are not getting a distorted picture of what normally happens in the situation that they are observing” (p374). Therefore, due to the specific purpose of the research, an interview was conducted with all the students.

Instrumentation

Assessing level of students' reflection of the instruction—Think aloud protocol

The think-aloud protocol is one type of verbal reporting method in which the researcher provides a task and asks subjects to say aloud everything that comes to mind as they are performing it (Wade, 1990). Rundall et al. (1986) stated that think-aloud protocols are powerful diagnostic tools and there are several ways college teachers can use them. Afflerbach & Johnston (1984) proposed a number of advantages of verbal report:

(1) Verbal report's validity relies on a different set of assumptions from those of most other methods of investigating cognitive processes.

(2) Under certain circumstances, verbal report provides the descriptions of cognitive processes which could not be investigated directly.
(3) Verbal report allows access to the reasoning processes underlying higher level cognitive activity.

(4) Retrospective reports are sometimes the only available way for historical or generic analysis of metal processes.

(5) Verbal reports allow an analysis of the affective components of reading processes.

According to Afflerbach & Johnston (1984), verbal report allows access to the reasoning processes underlying higher level cognitive activity. Loxtermman, Beck & McKeown (1994) also stated that thinking aloud has its greatest advantage: students need to work with a text that explicitly connects information and provides adequate explanations. Being asked to stop and talk about such a text may give students opportunities to reflect and think through information. The advantages of verbal report correspond to what the researcher tried to investigate in the study.

Validity

Ericsson & Simon (1993) stated that verbal reports can be, and should be, understood in exactly the same way as we understand other kinds of response. Thus, one could assume face validity of this technique was valid, because students were to reflect upon the instruction of the web-based courses and express their thoughts that accused during the think-aloud process with the researcher.

Reliability

Reliability of the instrument was based on the rater’s utilization of the instrument. The researcher rated the level of cognition of students’ thinking by Newcomb and Trefz’s (1987) taxonomy. After one week, the research rated the same students’ verbal
reports again. An intra-rater reliability (r = .90) was calculated by computing the percent of agreement upon the two ratings.

**Data collection**

Spring quarter in 2001 was selected as the period to collect data at The Ohio State University. Data collecting focused on the main objective: "assessing the level of students' reflective thinking of instruction".

The researcher adopted think aloud protocol to collect data regarding students’ reflective thinking levels of cognition. Before the interviews, the students received an introduction of the study and an explanation of the instrumentation utilized in the study. Immediately after the students read the on-line course materials, the students were given as much time as they needed to provide an oral retelling of what they recalled. At the same time, the researcher used a hand-held tape recorder to record what the subjects reported. The retellings were assessed by the Newcomb and Treft's taxonomy. Wade (1990) presented a detailed description of the procedure for administering and scoring a comprehension think-aloud data, which was also an important reference for the researcher when conducting the data collection (Appendix B).

**Data Analysis**

Previous research using verbal reporting has found that subjects exhibit individual differences and commonalities in their reported cognitive processes (Brown & Day, 1983; Chi, Glaser, & Rees, 1982; Garner, 1982; Johnston & Afflerbach, 1983). In order to characterize the similarity and differences between individuals' cognitive
strategies, developing response classification schemes is necessary (Afflerbach & Johnston, 1984). Randall et al. (1986) proposed a useful categorization to analyze the reports of think-aloud protocol. The researcher combined Randall et al., (1986) classification to categorize students' think-aloud response and adapted Newcomb and Trefz's (1987) modified version of the taxonomy to identify students' cognitive level of thinking (Figure 5). Only the thoughts and comments which were under the categories of meaning relevant comments, beyond the text and cognitive would be analyzed.

Figure 8. Modified Randall et al., (1986) and Newcomb and Trefz's categorization of analyzing the think-aloud protocol reports

After the interviews, the researcher recorded students' thoughts and identify the level of students' thoughts by Newcomb and Trefz's classification system and the
FTCB classification. Based on the FTCB instrument, examples of observable verbs at each level of Newcomb and Trefz's (1987) taxonomy include: "gives steps of process, describe method" (remembering level); "summarizes or concludes from observation of evidence" (processing level); "reorganize ideas, materials and processes" (creating level) and "evaluates something from evidence" (evaluating level).

After the cognitive levels of students' reflective thinking were identified, the frequency distribution was used to analyze data. Frequency of level of students' thinking attained across all cognitive levels was totaled. The percentage of students' thinking attained at each cognitive level was calculated (Table 2).

<table>
<thead>
<tr>
<th>Level of cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Processing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Creating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Evaluating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Frequency distribution of level of students' thinking attained
CHAPTER 4

FINDINGS AND CONCLUSIONS

The purpose of this study was to describe the cognitive level of instruction of a selected web-enhanced course and describe the cognitive level of students' reflective thinking in the same course, which was offered at The Ohio State University. This chapter will present the purpose of the study, objectives of the study, population, instrumentation, findings and results.

Objectives of the study

The objectives of the study were to:

1. Describe the levels of cognition of the teaching materials of a selected web-enhanced course, in terms of the following selected aspects:
   A. Course objectives
   B. In-class discourse,
   C. On-line course content,
   D. Out-of-class assignments and
   E. On-line discussion forum

2. Describe the cognitive level of students' reflective thinking of the course content in the web pages through a
A. Think-aloud protocol interview, and

B. Students’ discussion in the on-line forum

3. Compare the cognitive level of instruction and cognitive level of students’ reflective thinking.

Population Characteristics

Teaching materials (Instruction)

The target population for the study consisted of a web-enhanced course in the distance education program (TELR) at OSU. Due to practical limitations of time, money and the professor’s agreement to participate, one course was purposively selected.

Students’ reflective thinking

The population of this study consisted of thirteen graduate students who were enrolled in the selected web-enhanced course at OSU during the Spring Quarter of 2001. Due to the specific purpose of the research, an interview was conducted with all the students.

Instrumentation

Measuring cognitive level of instruction

In this study, the modified version of Newcomb and Trefz’s taxonomy was used to assess the level of cognition of teaching materials of the web-based course. Newcomb and Trefz (1987) developed a modified version of Bloom’s taxonomy, which included four specific levels:
1. Remembering
2. Processing
3. Creating
4. Evaluating

The researcher adopted the taxonomy to identify the cognitive level of course objective, in-class discourse, on-line course content, out-of-class assignments and teacher’s responses in the on-line discussion forum of this course.

Assessing level of students’ reflective thinking of the on-line course content—

Think aloud protocol

The think-aloud protocol is a type of verbal reporting method in which the researcher provides a task from the course content and asks subjects to say aloud everything that comes to mind as they are performing it (Wade, 1990). In this study, the research used the think-aloud protocol to collect data on students’ cognitive level of thinking.

Thoughts of students were classified into the following categories:

1. Metacommens
2. Meaning relevant comments which are restricted to the text
3. Affective or Metacognitive comments, which is beyond the text
4. Cognitive comments, which is beyond the text

Only thoughts under the last category (cognitive comments) would be analyzed quantitatively and were classified by Newcomb and Trefz’s taxonomy.
Major findings

Objective I. To describe the levels of cognition of the teaching materials of the selected web-enhanced course, in terms of the following selected aspects:

A. Course objectives,
B. In-class discourse,
C. On-line course content, and
D. Out-of-class assignments
E. On-line discussion forum

Table 3 through Table 7 presented the levels of cognition of the instruction of the selected web-enhanced course. The measures were classified by Newcomb and Trefz's taxonomy, i.e., remembering, processing, creating and evaluating. Frequencies and percentages for each category at each level are presented in Table 3 through Table 7.

Assessed cognitive level of "course objectives"

Table 3 showed the information about the level of cognition of objectives which the web-enhanced course intended to deliver. From the data presented in Table 3, the objectives of the course intended to teach 29% at the remembering level of cognition, 41% at the processing level, 17% at the creating level and 13% at the evaluation level. According to the course objectives, the "processing" level was intended to be delivered most frequently and the "evaluation" level intended to deliver least frequently.
<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>16</td>
<td>29</td>
</tr>
<tr>
<td>2. Processing</td>
<td>22</td>
<td>41</td>
</tr>
<tr>
<td>3. Creating</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 3. Frequency Distribution of the Level of Cognition of the Objective of the Course

Assessed cognitive level of "in-class discourse"

Table 4 showed the information about the assessed cognitive level of in-class discourse. From the data presented in Table 4, the in-class discourse was taught 26% at the remembering level of cognition, 51% at the processing level, 9% at the creating level and 14% at the evaluation level. In the class discourse, the most frequently utilized was the "processing" level and the least frequently utilized was the "creating" level.

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>33</td>
<td>26</td>
</tr>
<tr>
<td>2. Processing</td>
<td>65</td>
<td>51</td>
</tr>
<tr>
<td>3. Creating</td>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 4. Frequency Distribution of the Level of Cognition of In-class Discourse
Table 5 showed a comparison of the percentage of the cognitive level between the course objective and in-class discourse. Data indicated that from the course objective, the “processing” level was expected to be utilized most frequently and this level was utilized most frequently in in-class discourse. At the “remembering” level and “evaluation” level, the percentage of difference between the course objective and in-class discourse were below 3%. The “creating” level was intended to teach 17% and was taught 9% in the classroom.

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Course Objective (%)</th>
<th>In-class Discourse (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>29</td>
<td>26</td>
</tr>
<tr>
<td>2. Processing</td>
<td>41</td>
<td>51</td>
</tr>
<tr>
<td>3. Creating</td>
<td>17</td>
<td>9</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 5. Comparison of the Cognitive levels of Course Objectives and the In-Class Discourse

Assessed cognitive level of “on-line course content”

Table 6 showed the information about the level of cognition of on-line course content. From the data presented in Table 6, the course content on the web taught 28% of the time at the remembering level of cognition, 38% at the processing level, 11% at the creating level and 23% at the evaluation level. The on-line course content taught most frequently at the “processing “ level and least frequently at the “ creating “ level.
<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>24</td>
<td>28</td>
</tr>
<tr>
<td>2. Processing</td>
<td>32</td>
<td>38</td>
</tr>
<tr>
<td>3. Creating</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>84</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 6. Frequency Distribution of the Level of Cognition of the On-line Course Content

Table 7 showed a comparison of the percentage of the cognitive level between the course objective and on-line course content. Data indicated that from the course objective, the “processing” level was expected to be utilized most frequently and this level was utilized most frequently in on-line course content. At the “remembering” level and “processing” level, the percentage of difference between the course objective and in-class discourse were below 3%. The “creating” level was intended to teach 17% and was taught 11% in the on-line course content. The “evaluation” level was intended to teach 13% and 23% was taught in the on-line course content.
Table 7. Comparison of Cognitive level of Course Objectives and Cognitive level of the On-line Course Content

Table 8 showed a comparison of the percentage of the cognitive level between the in-class discourse and on-line course content. Data indicated that the “processing” level was utilized most frequently both in in-class discourse (51%) and on-line course content (38%). At the “remembering” level and “creating” level, the percentage of difference between the course objective and in-class discourse were below 3%. The “evaluation” level was taught 14% in in-class discourse and 23% in the on-line course content.

Table 8. Comparison of Cognitive level of In-class Discourse and On-line Course Content

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>In-class discourse (%)</th>
<th>On-line Course Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>26</td>
<td>28</td>
</tr>
<tr>
<td>2. Processing</td>
<td>51</td>
<td>38</td>
</tr>
<tr>
<td>3. Creating</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
Assessed cognitive level of "out-of-class assignments"

Table 9 showed the information about the assessed cognitive level of out-of-class assignments. From the data presented in Table 9, the out-of-class assignments were assessed 4% of the time at the remembering level of cognition, 32% at the processing level, 39% at the creating level and 25% at the evaluation level. In out-of-class assignments, the most frequently utilized cognitive level was the "creating" and the least frequently utilized level was the "remembering".

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2. Processing</td>
<td>9</td>
<td>32</td>
</tr>
<tr>
<td>3. Creating</td>
<td>11</td>
<td>39</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>7</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 9. Frequency Distribution of the Level of Cognition of Out-of-Class Assignments

Table 10 showed a comparison of the percentage of the cognitive level between the course objective and out-of-class assignments. Data indicated that the "processing" level was expected to be utilized most frequently; however, the "creating" level was utilized most frequently (39%) in out-of-class assignments. At the "remembering" level, the difference between the percentages of course objective (29%) and the percentage of out-of-class assignments (4%) was 25%. At the "evaluation" level, the difference between the percentage of the course objective (13%) and the percentage of
out-of-class assignments (25%) was 12%. Out-of-class assignments tended to achieve higher percentages in higher order thinking levels than other aspects of instruction.

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Course Objective (%)</th>
<th>Out-of-class Assignments (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>29</td>
<td>4</td>
</tr>
<tr>
<td>2. Processing</td>
<td>41</td>
<td>32</td>
</tr>
<tr>
<td>3. Creating</td>
<td>17</td>
<td>39</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 10. Comparison of Cognitive level of Course Objectives and Out-Class Assignments

Table 11 showed a comparison of the percentage of the cognitive level between in-class discourse and out-of-class assignments. Data indicated that in-class discourse tended to achieve higher percentage at lower cognitive level; for example: the “processing” level was utilized most frequently in in-class discourse (51%) and the “remembering” level was utilized 26% of in-class discourse. The “creating” level was utilized least frequently in in-class discourse (9%). However, the “creating” level was utilized most frequently in out-of-class assignments (39%). Data indicated that out-of-class assignments tended to achieve a higher percentage at higher cognitive level. From the data presented, out-of-class assignments were assessed 4% of the time at the remembering level of cognition, 32% at the processing level, 39% at the creating level and 25% at the evaluation level.
Table 11. Comparison of Cognitive level of In-class Discourse and Out-of-class Assignments

Table 12 showed a comparison of the percentage of the cognitive level between on-line course content and out-of-class assignments. Data indicated that, compared to out-of-class assignments, on-line course content tended to achieve higher percentage at lower cognitive levels (66%) and the out-of-class assignments tended to achieve higher percentage at higher cognitive levels (64%).

Table 12. Comparison of Cognitive level of On-line Course Content and Out-of-Class Assignments
Assessed cognitive level of "the teacher's responses in the on-line discussion forum"

Table 13 showed the information about the cognitive level of teacher's responses in the on-line discussion forum. From the data presented in Table 13, the teachers' response in the forum discussion were assessed 3% of the time at the remembering level, 71% at the processing level, 21% at the creating level and 5% at the evaluation level. The most frequently utilized level by the instructors in the on-line forum was at the "processing" level and the least frequently utilized level by the instructors in the on-line forum was at the "remembering" level.

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2. Processing</td>
<td>27</td>
<td>71</td>
</tr>
<tr>
<td>3. Creating</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 13. Frequency Distribution of the Level of Cognition of "Teachers' Response in the On-line Discussion Forum"

Table 14 showed a comparison of the percentage of the cognitive level between the course objective and teachers' responses in the on-line discussion forum. Data indicated that, "processing" level was expected to utilize most frequently (41%) in the
course objective and this level was utilized 30% higher in teachers’ responses in the on-line discussion forum (71%) than course objective expected. At the "remembering" level and "evaluation" level, the percentages were much lower than the course objective expected. The "creating" level was intended to be the level taught 17% and was taught 21% in teacher’s responses in the on-line discussion forum.

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Course Objective (%)</th>
<th>Teacher’s Responses in the On-line Discussion Forum (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>29</td>
<td>3</td>
</tr>
<tr>
<td>2. Processing</td>
<td>41</td>
<td>71</td>
</tr>
<tr>
<td>3. Creating</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 14. Comparison of Cognitive level of Course Objectives and Cognitive level of the “Teachers’ Response in the On-line Discussion Forum”

Table 15 showed a comparison between the percentages of the cognitive level of the on-line course content and the cognitive level of teacher’s responses in the on-line discussion forum. Data indicated that the “processing” level was utilized most frequently both in on-line course content (38%) and teacher’s responses in the on-line discussion forum (71%). At the “remembering” level, the percentage of difference between the on-line course content (28%) and teacher’s responses in the on-line discussion forum (3%) was 25%. The “evaluation” level was taught 23% in the on-line course content and 5% in teacher’s responses in the on-line discussion forum. The
cognitive level of teacher’s responses in the on-line discussion forum mainly focused on the “processing” level.

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>On-line Course Content (%)</th>
<th>Teacher’s Responses in the Forum (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remembering</td>
<td>28</td>
<td>3</td>
</tr>
<tr>
<td>Processing</td>
<td>38</td>
<td>71</td>
</tr>
<tr>
<td>Creating</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Evaluating</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 15. Comparison of Cognitive level of On-line Course Content and Teacher’s Responses in the On-line Discussion Forum

Summary of the Distribution of the Cognitive Level of Instruction

Table 16 showed a comparison of the percentage of the cognitive level between the course objective and four other aspects of instruction. At the “creating” level, data indicated that out-of-class assignments has the highest percentages (39%) and was 21% higher than course objectives (17%). Teacher’s responses in the on-line discussion forum had a higher percentage at the “creating” level (21%) than course objective intended to reach (17%). The “processing” level was utilized most frequently in most aspects of instruction; especially the percentage of teacher’s responses in the on-line discussion forum was very high at the “processing” level (71%). At the “remembering” level, in-class discourse and on-line course content had similar percentages (26% and 28%) and both correspond to the percentage which course
objective intended to reach (29%). Data indicated that both out-of-class assignments and teacher's response in the forum had very low percentage at the "remembering" level (4% and 3%). At the "evaluation" level, course objective intended to teach 13% and in-class discourse has the similar percentage (14%). On-line course content and out-of-class assignments has higher percentages at the "evaluation" level (23% and 25%); however, teacher's responses in the discussion forum had a very low percentage at this cognitive level (5%).

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Course Objective (%)</th>
<th>In-class Discourse (%)</th>
<th>On-line Course Content (%)</th>
<th>Out-of-class Assignments (%)</th>
<th>Teacher's Responses in the Discussion Forum (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>29</td>
<td>26</td>
<td>28</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2. Processing</td>
<td>41</td>
<td>51</td>
<td>38</td>
<td>32</td>
<td>71</td>
</tr>
<tr>
<td>3. Creating</td>
<td>17</td>
<td>9</td>
<td>11</td>
<td>39</td>
<td>21</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>13</td>
<td>14</td>
<td>23</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 16. A Summary of Comparison of Cognitive level of Course Objective and Other Aspects of Instruction

Table 17 presented a summary of the distribution of the cognitive level of instruction in five aspects: course objective, in-class discourse, on-line course content, out-of-class assignments and teachers' responses in the on-line forum discussion.

From the data presented in Table 17, the average percentage of the "processing" level in these five areas was utilized most frequently (46.6%) and the "remembering" (18%), "creating" (19.4%) and "evaluation" levels (16%) have similar average percentages.
### Table 17. A Summary of the Distribution of the Cognitive Level of the Instruction In the Selected Web-enhanced Course

<table>
<thead>
<tr>
<th>Level of cognition</th>
<th>Course Objective (%)</th>
<th>In-class Discourse (%)</th>
<th>On-line Content (%)</th>
<th>Out-class Assignments (%)</th>
<th>Discussion Forum (%)</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>29</td>
<td>26</td>
<td>28</td>
<td>4</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>2. Processing</td>
<td>41</td>
<td>51</td>
<td>38</td>
<td>32</td>
<td>71</td>
<td>46.6</td>
</tr>
<tr>
<td>3. Creating</td>
<td>17</td>
<td>9</td>
<td>11</td>
<td>39</td>
<td>21</td>
<td>19.4</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>13</td>
<td>14</td>
<td>23</td>
<td>25</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 18 presented a comparison of the distribution of course objective and the distribution of the average percentage of the cognitive level of the whole instruction. Data showed that they have similar distribution of the cognitive level. However, in higher cognitive levels (the "creating" level and the "evaluation" level), the average percentage of the cognitive level of the total instruction was 5 % higher than the cognitive level of course objectives.
Table 18. Comparison of Cognitive Level of Course Objectives and the Average Percentage of Total Instruction

Table 19 compared the distribution of in-class discourse and the distribution of the average percentage of the cognitive level of the whole instruction. The percentage in higher cognitive level (the “creating” level and the “evaluation” level) of the in-class discourse (23%) was 12% lower than the percentage in higher cognitive level average (35.4%).

Table 19. Comparison of Cognitive Level of In-class Discourse and Average Percentage of Total Instruction

Table 20 compare the distribution of on-line course content and the distribution of the average percentage of the cognitive level of the whole instruction. The
percentage in higher cognitive level (the "creating" level and the "evaluation" level) of
the on-line course content (34%) was similar to the percentage in higher cognitive level
average (35.4%).

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>On-line Content (%)</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>2. Processing</td>
<td>38</td>
<td>46.6</td>
</tr>
<tr>
<td>3. Creating and Evaluating</td>
<td>34</td>
<td>35.4</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 20. Comparison of Cognitive Level of On-line Course Content and the
Cognitive level of Average Percentage of Total Instruction

Table 21 showed a comparison of the distribution of the out-of-class
assignments and the distribution of the average percentage of the cognitive level of the
whole instruction. The percentage in higher cognitive level (the "creating" level and
the "evaluation" level) of the out-of-class assignments (64%) was much higher than the
percentage in higher cognitive level average (35.4%).

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Out-of-Class Assignments (%)</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>2. Processing</td>
<td>32</td>
<td>46.6</td>
</tr>
<tr>
<td>3. Creating and Evaluating</td>
<td>64</td>
<td>35.4</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 21. Comparison of Cognitive Level of Out-of-Class Assignments and the
Cognitive level of Average Percentage of Total Instruction
Table 22 compared the distribution of the discussion forum and the distribution of the average percentage of the cognitive level of the whole instruction. The percentage in higher cognitive level (the "creating" level and the "evaluation" level) of the discussion forum (26%) was approximately 10% lower than the percentage in higher cognitive level of average percentage (35.4%).

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Discussion Forum (%)</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>2. Processing</td>
<td>71</td>
<td>46.6</td>
</tr>
<tr>
<td>3. Creating and Evaluating</td>
<td>26</td>
<td>35.4</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 22. Comparison of Cognitive Level of On-line Course Content and Average Percentage of Total Instruction

Table 23 presented a summary of distribution of higher cognitive levels in all aspects of the instruction. The course objective intended to teach 30% of the time at higher cognitive levels and the average percentage of higher cognitive levels was 35.4%. In all aspects of the instruction, out-of-class assignments had the highest percentage of higher cognitive levels (64%) and on-line course content had the second highest percentage (34%). In-class discourse (23%) and teachers' responses in the on-line discussion forum (26%) had lower percentages of higher cognitive levels than both course objective (30%) and the percentage in higher cognitive level average (35.4%).
Table 23. A Summary of the Distribution of Higher Cognitive Levels in Total Instruction of the Instruction

<table>
<thead>
<tr>
<th>Level of cognition</th>
<th>Course Objective (%)</th>
<th>In-class Discourse (%)</th>
<th>On-line Content (%)</th>
<th>Out-class Assignments (%)</th>
<th>Discussion Forum (%)</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>29</td>
<td>26</td>
<td>28</td>
<td>4</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>2. Processing</td>
<td>41</td>
<td>51</td>
<td>38</td>
<td>32</td>
<td>71</td>
<td>46.6</td>
</tr>
<tr>
<td>3. Creating and Evaluating</td>
<td>30</td>
<td>23</td>
<td>34</td>
<td>64</td>
<td>26</td>
<td>35.4</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Objective II. To describe the levels of cognition of students' reflective thinking in terms of the following selected aspects:

A. Think-aloud protocol interview

B. Students’ discussion in the on-line forum

Table 24 and Table 25 presented the levels of cognition of the students’ reflective thinking of the selected web-enhanced course. The measures were classified by Newcomb and Trefz's taxonomy, i.e.; remembering, processing, creating and evaluating. Frequencies and percentages for each category at each level are presented in Table 24 and Table 25.

Assessed cognitive level of students’ reflective thinking during the Think-aloud interviews

Table 24 showed the information about the level of cognition of students’ reflective thinking of the on-line course content during the Think-aloud interviews.

Data indicated that the most common type of students’ thoughts was at the
“processing” level (51%) and the least common type of students’ thoughts was at the “remembering” level (11%). Students’ thoughts were assessed as 17% at the “creating” level and as 21% at the “evaluating” level.

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>18</td>
<td>11</td>
</tr>
<tr>
<td>2. Processing</td>
<td>82</td>
<td>51</td>
</tr>
<tr>
<td>3. Creating</td>
<td>27</td>
<td>17</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>33</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>160</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 24. Frequency Distribution of the Level of Cognition of Students’ Reflective Thinking From Think-aloud Protocol Interview

Assessed cognitive level of students’ reflective thinking in the on-line forum discussion

Table 25 showed the information about the level of cognition of students’ reflective thinking in the on-line forum discussion. From the data presented in Table 25, the most common type of students’ thoughts was at the “processing” level (62%) and only 1.5% was at the “remembering” level. Students’ thoughts from on-line discussion forum were assessed 19% at the “creating” level and 17.5% at the “evaluating” level.
<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>2. Processing</td>
<td>46</td>
<td>62</td>
</tr>
<tr>
<td>3. Creating</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>13</td>
<td>17.5</td>
</tr>
<tr>
<td>Total</td>
<td>74</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 25. Frequency Distribution of the Level of Cognition of Students’ Reflective Thinking from On-line Discussion Forum

Summary of the Distribution of the Cognitive Level of Students’ Reflective Thinking

Table 26 presented a summary of the distribution of the cognitive level of students’ reflective thoughts in two aspects: Think-aloud interview and on-line forum discussion. From the data presented in Table 26, “processing” level was utilized more frequently (56.5%) than the other three levels: “remembering” (6.25%), “creating” (18%) and “evaluation” levels (19.25%) in students’ thoughts.

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Think-aloud Interview (%)</th>
<th>On-line Discussion Forum (%)</th>
<th>Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>11</td>
<td>1.5</td>
<td>6.3</td>
</tr>
<tr>
<td>2. Processing</td>
<td>51</td>
<td>62</td>
<td>56.5</td>
</tr>
<tr>
<td>3. Creating</td>
<td>17</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>4. Evaluating</td>
<td>21</td>
<td>17.5</td>
<td>19.2</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 26. A Summary of the Percentage of the Cognitive Level of Student’s Reflective Thinking
Objective III. To compare the levels of cognition of the teaching materials and levels of cognition of students' reflective thinking

Based on the data from Table 6 and Table 23, Table 27 compared the levels of cognition of the on-line course content and the students' reflective thinking of the on-line course content from the Think-aloud protocol interview.

Table 27 indicated that the most common cognitive level utilized by both teachers and students of the on-line course content were the “processing” level (38% and 51%, see Table 27). At the “remembering” level, the teacher taught 28% at the time and 11% was assessed of students’ thoughts. The teacher taught 11% at the “creating” level in the on-line course content and 17% was assessed of students’ thoughts at this level. The percentages of both the teacher’s and students’ cognitive level were similar at the “evaluation” level (23% and 21%).

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Instruction (%)</th>
<th>Students (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>2. Processing</td>
<td>38</td>
<td>51</td>
</tr>
<tr>
<td>3. Creating</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>4. Evaluation</td>
<td>23</td>
<td>21</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Table 27. Comparison of Cognitive level of the On-line Course Content and of Students’ Reflective Thinking of the On-line Course Content
Based on the data from Table 13 and Table 24, Table 28 compared the level of cognition of “teacher’s response and the level of cognition of “students’ reflective thinking” in the on-line discussion forum.

Table 28 indicated that the most common cognitive level utilized by both teachers and students in the on-line discussion forum were at the “processing” level (71% and 62%). The least common cognitive level utilized by both teachers and students were at the “remembering” level (3% and 1.5%). At the “creating” level, the percentages of both the teacher’s and students’ cognitive level were similar (21% and 19%). At the evaluation level, students utilized approximately 13% higher than the teacher in the on-line discussion forum (17.5% and 5%).

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Instruction (%)</th>
<th>Students (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>2. Processing</td>
<td>71</td>
<td>62</td>
</tr>
<tr>
<td>3. Creating</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>4. Evaluation</td>
<td>5</td>
<td>17.5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 28. Comparison of the Cognitive Level of “the Teacher’s Responses” and of “Students’ Reflective Thinking” in the On-line Discussion Forum

Based on the data from Table 17 and Table 26, Table 29 compared the levels of cognition of total instruction and total students’ reflective thinking of the selected web-enhanced course. The measures were classified by Newcomb and Trefz’s taxonomy, i.e., remembering, processing, creating and evaluating.
Data presented in Table 29 indicated that the most common cognitive level utilized by both teachers and students were at the “processing” level (40% and 56.5%, see Table 16). The “Remembering” level was utilized least frequently for both of them (19% and 6.3%). The percentages of both teachers’ and students’ cognitive level are equally distributed in the “creating” (20% and 18%) and “evaluation” level (21% and 19.2%).

<table>
<thead>
<tr>
<th>Level of Cognition</th>
<th>Instruction (%)</th>
<th>Students (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Remembering</td>
<td>18</td>
<td>6.3</td>
</tr>
<tr>
<td>2. Processing</td>
<td>46.6</td>
<td>56.5</td>
</tr>
<tr>
<td>3. Creating</td>
<td>19.4</td>
<td>18</td>
</tr>
<tr>
<td>4. Evaluation</td>
<td>16</td>
<td>19.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Table 29. Comparison of Cognitive level of Total Instruction and of Students’ Reflective Thinking
CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Purpose

The purpose of this study was to describe the cognitive level of instruction of a
selected web-enhanced course and describe the cognitive level of students' reflective
thinking in the course at The Ohio State University.

Research Design

This was a descriptive study. Relevant instruments were used in order to
accomplish the following objectives:

1. Describe the levels of cognition of the teaching materials of a selected web-

enhanced course, in terms of the following selected aspects:

   A. Course objectives

   B. In-class discourse,

   C. On-line course content,

   D. Out-of-class assignments and

   E. On-line discussion forum

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2. Describe the cognitive level of students' reflective thinking in terms of the following selected aspects:
   A. Think-aloud protocol interview, and
   B. Students' discussion in the on-line forum

3. Compare the cognitive level of instruction and cognitive level of students' reflective thinking.

Population and Sample

Teaching materials (Instruction)

The target population for the study consisted of the web-enhanced courses offered at OSU. Due to practical limitations of time, money and professors' agreement to participate, one sample course was selected purposively. The study can not make unbiased inferences to populations and the generalization of the results would be limited. However, this study emphasized designing the study to optimize understanding of the case rather than generalization beyond (Stake, 1998).

Students' reflective thinking

The population of this study consisted of thirteen graduate students, who enrolled in the selected web-enhanced course at OSU during the Spring Quarter of 2001. Due to the specific purpose of the research, a census interview was conducted to all the students.

Instrumentation

Two instruments were used to collect data and address the objectives of this study.
1. Measuring cognitive level of instruction

In this study, the modified version of Newcomb and Trefz's (1987) taxonomy was used to assess the level of cognition of teaching materials of the web-enhanced course. The taxonomy included four specific levels:

1. Remembering
2. Processing
3. Creating
4. Evaluating

The researcher adopted the taxonomy to identify the cognitive level of in-class discourse, out-class assignments and course content on the web pages. The researcher observed the course content on the web pages and wrote down the actual levels of cognition of instruction delivered.

2. Assessing level of students' reflective thinking of the on-line course content—Think aloud protocol

The think-aloud protocol is one type of verbal reporting method in which the researcher provides a task and asks subjects to say aloud everything that comes to mind as they are performing it (Wade, 1990). In this study, the research used think-aloud protocol to collect data of students' cognitive level of thinking in the study.
Data Collection

Measuring cognitive level of instruction

Based on the comparison table between Bloom’s Taxonomy, the Florida Taxonomy of Cognitive Behavior (FTCB) and The Newcomb-Trefz Model (Figure 4). The modified Florida Taxonomy of Cognitive Behavior instrument (Appendix A) was used to help to identify the cognitive level attained of the teaching materials.

<table>
<thead>
<tr>
<th>Bloom’s Taxonomy</th>
<th>FTCB</th>
<th>Newcomb-Trefz Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Knowledge</td>
<td>Remembering</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Translation</td>
<td>Processing</td>
</tr>
<tr>
<td></td>
<td>Interpretation</td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td>Application</td>
<td></td>
</tr>
<tr>
<td>Analysis</td>
<td>Analysis</td>
<td></td>
</tr>
<tr>
<td>Synthesis</td>
<td>Synthesis</td>
<td>Creating</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Evaluation</td>
<td>Evaluation</td>
</tr>
</tbody>
</table>

Figure 9. The comparison between Bloom’s Taxonomy, The Florida Taxonomy of Cognitive Behavior (FTCB) and The Newcomb-Trefz Model

2. Assessing level of students’ reflection of the instruction—Think aloud protocol

The researcher adopted think aloud protocol to collect data of students’ reflective thinking. The researcher interviewed the thirteen students individually, and the students were asked to recall and describe their thoughts of the identified on-line course contents with different level of cognitive instruction. At the same time, the researcher used a hand-held tape recorder to record what the subjects reported.
Data Analysis

Descriptive statistics were used to summarize the data, such as: frequency, total, and percentages.

Summary of Findings

Findings of the study are summarized below:

Objective 1. To describe the levels of cognition of the teaching materials of a selected web-based course, in terms of the following selected aspects: course objectives, in-class discourse, on-line course content, and out-class assignments

(1) Course objectives

The objective of the selected web-enhanced course intended to teach 29% of the time at the remembering level of cognition, 41% at the processing level, 17% at the creating level and 13% at the evaluation level. The most frequent intended cognitive level of the course objective was the "processing" level and the least frequent intended level was at the "evaluation" level.

(2) In-class discourse

The in-class discourse was mainly taught at the processing level (51%), and the least frequently utilized cognitive level in the classroom was the "creating" level (9%).

(3) On-line course content

The on-line course content was taught most frequently at the "processing" level and the least frequently at the "creating" level. The course content on the web
taught 28% of the time at the remembering level of cognition, 38% at the processing level, 11% at the creating level and 23% at the evaluation level.

(4) Out-of-class assignments

The out-of-class assignments were assessed most frequently at the “creating” level (39%) and least frequently at the “remembering” level. The out-of-class assignments were assessed mainly at the higher level of cognition (39% creating and 25% evaluation) and 32% at the processing level.

(5) Teachers’ responses in the on-line discussion forum

Teachers’ responses in the on-line discussion forum were assessed 3% of the time at the remembering level, 71% at the processing level, 21% at the creating level and 5% at the evaluation level. The most frequently utilized level by the teachers in the on-line discussion forum was at the “processing” level and the least frequently utilized level was at the “remembering” level.

(6) Summary of the distribution of the cognitive level of course objectives, in-class discourse, on-line course content, out-class assignments and teachers’ responses in the on-line discussion forum

The “Processing” level was utilized most frequently (46.6%) in the instruction and the “remembering” (18%), “creating” (19.4%) and “evaluation” level (16%) were utilized rather equally in this course.

Data indicated that both out-of-class assignments and teacher’s response in the forum had very low percentage at the "remembering" level (4% and 3%). In all aspects of the instruction, out-of-class assignments have the highest percentage of higher
cognitive levels (64% at the creating and evaluation levels) and on-line course content has the second highest percentage (34% at the creating and evaluation levels).

In-class discourse (23%) and teachers' responses in the on-line discussion forum (26%) had lower percentages of higher cognitive levels than course objective (30%) and average percentage of all aspects (35.4%).

**Objective 2. To describe the levels of cognition of students' reflective thinking of the teaching materials**

(1) **Think-aloud protocol interview**

The most common type of students' thoughts from the interviews was at the "processing" level (51%) and 11% at the "remembering" level, 17% at the "creating" level and 21% at the "evaluation" level.

(2) **Students' discussion in the on-line forum**

The most common type of students' thoughts in the discussion forum was at the "processing" level (62%) see and only 1.5% was at the "remembering" level.

(3) **Summary of the distribution of the cognitive level of students' reflective thoughts**

The "Processing" level was utilized much more frequently (56.5%) than other three levels: "remembering" (6.25%), "creating" (18%) and "evaluation" levels (19.25%) in students' thoughts. Data indicated that the most common type of students' thoughts of the on-line course contents was at the "processing" level (51%) and the least common type of students' thoughts was at the "remembering" level (11%). The
most common type of students' thoughts in the on-line discussion forum was also at the
"processing" level (62%) and only 1.5% was at the "remembering" level.

Objective 3. To compare the levels of cognition of the teaching materials and
levels of cognition of students' reflective thinking

The most common cognitive level utilized by both teachers and students were
the "processing" level (40% and 56.5%). The "remembering" level was utilized least
frequently of both of them (19% and 6.3%). The percentages of both teachers' and
students' cognitive level were equally distributed in the "creating" (20% and 18%) and
"evaluation" level (21% and 19.2%).

In the aspect of on-line course content, the most common cognitive level
utilized by the teacher and students were the "processing" level (38% and 51%). At the
"remembering" level, the teacher taught 28% at the instruction and 11% was utilized by
students. The teacher taught 11% at the "creating" level in the on-line course content
and 17% was utilized by students at this level. The percentages of both the teacher's
and students' cognitive level were similar at the "evaluation" level (23% and 21%).

In the aspect of on-line discussion forum, the most common cognitive level
utilized by both teachers and students in the on-line discussion forum were at the
"processing" level (71% and 62%). The least common cognitive level utilized by both
teachers and students were at the "remembering" level (3% and 1.5%). At the
"creating" level, the percentages of both the teacher's and students' cognitive level were
similar (21% and 19%). At the evaluation level, students utilized approximately 13%
higher than the teacher in the on-line discussion forum (17.5% and 5%).
Conclusions

The following conclusions are drawn from the findings and based upon the researcher's interpretation of the results of the study.

Conclusion 1

In this study, the “processing” level was expected to be utilized most frequently based on the course objectives and this level was assessed to be utilized most frequently in the classroom, on-line course content and discussion forum. However, out-of-class assignments were assessed to offer more opportunities of higher order thinking for students.

Conclusion 2

In this study, the majority (40%) of the overall instruction was attained at the “processing” level. Each of the “remembering” level, “creating” level and “evaluation” level was utilized rather equally at about 20%.

Conclusion 3

In this study, the distribution of the cognitive level delivered by the overall instruction pretty much correspond to the distribution of cognitive level which the course objectives intended to reach. The results showed that the level of cognition proposed to be taught in the course was taught.

Conclusion 4

The cognitive level of students’ reflective thoughts in this study was primarily assessed at the “processing” level and the percentage of students’ reflective thoughts at the “remembering” was very low (6.3%).
Conclusion 5

In the on-line discussion forum, the percentage of teachers’ responses at “remembering” level was 3% and the percentage of students’ reflective thoughts at “remembering” level was lower than 2%. The results showed that the ongoing communication in the on-line discussion forum offered more opportunities for higher order cognitive level of teaching and thinking.

Conclusion 6

The majority (56.5%) of the overall students’ reflective thoughts were at the “processing” level. According to the interview results and the comments students posted on the discussion forum, the “application” category in the Florida Taxonomy of Cognitive Behavior was the most common category. The participants in this study very often applied the knowledge to their own practical situations.

Conclusion 7

The “processing” level was the most common cognitive level utilized in the overall instruction and in students’ reflective thoughts. The “remembering” level was utilized least frequently both in the instruction and in students’ thoughts.

Conclusion 8

In general, little difference existed between the distributions of assessed cognitive level of in-class discourse and assessed cognitive level of on-line course content. The “processing” level was most commonly utilized in both of them.
Conclusion 9

The "creating" level was the most common cognitive level utilized in out-of-class assignments. The results in this study showed that out-of-class assignments attained a higher cognitive level than in-class discourse and on-line course content.

Conclusion 10

In general, on-line course content was not assessed to attain higher cognitive levels than in-class discourse; however, on-line discussion was assessed to attain a very low percentage at the "remembering" level, which was the lowest cognitive level of thinking. The results showed that the on-line discussion forum offers more opportunities in higher order thinking.

Discussion

The goal of this study was that, through the study of the web-enhanced course, insights can be gained that will suggest ways to help the pedagogical development of other web-enhanced courses. Specific topics of discussion included: cognitive level of instruction in the classroom, cognitive level of instruction on the web, and cognitive level of out-class assignments.

Cognitive level of instruction in the classroom

The data from this study showed that the "processing" level was the most common utilized level in the classroom and the proportion of processing level was 10% higher than desired based on the course objectives. However, compared to the previous studies, the percentage of higher cognitive level thinking in this web-enhanced course is high. In this course, both the instructors and students were
possibly more aware of higher cognitive level of thinking than might be the teacher and students in other courses since it was a course to “teach how to teach” (Appendix C). This might explain the high percentage in high cognitive level of thinking both in instruction and students’ reflective thoughts than other previous studies.

**Cognitive level of instruction and students’ reflective thoughts on the web**

Based on the conclusion of this study, on-line course content was not assessed to attain a higher cognitive level than in-class discourse. However, in the on-line discussion forum, the percentage of the teacher’s responses at the “remembering” level was 3% and the percentage of students’ reflective thoughts at the “remembering” level was lower than 2%. The results showed that the on-line discussion forum offered more opportunities in higher order thinking than in lower level thinking.

Compared to the in-class discussion, students could take time to think things over before responding to others students’ postings in the on-line discussion forum. For teachers, they could ask follow-up questions to a specific posting in the forum. The ongoing communication, which the on-line discussion forum offered, might be the reason that this aspect of instruction attained more higher order cognitive levels (the creating and evaluation levels) of teaching and thinking. An on-line discussion forum might also be one way for teachers to observe how students’ knowledge was organized and their thinking process through the on-going communication. In addition, in the on-line discussion forum, students or instructors could go back to a specific discussion topic and post their comments anytime. The on-line discussion forum could also benefit students who feel more comfortable to post their opinions on the web rather
than speaking in the classroom. The results of this study showed that students posted most often on the discussion forum were not the same persons who speak most often in the classroom.

**Challenges of on-line instruction in this study**

Many studies have pointed out the advantages of Internet distance education, for instance: they allow for constant personal interaction between the student and instructors; they allow much greater time flexibility and they expand resource opportunities through access to the WWW. In this course, most students did enjoy searching and collecting information on the Internet. The website material did reinforce the classroom learning; however, from the results of this study, some challenges existed with on-line learning. First, although the on-line learning did provide great flexibility for both the instructor and students, it is better for those who are self-disciplined. For instance, although there are a lot of resources on the WWW; according to the interview, not every student read every online resource which the instructors provided. Second, it was rather difficult for some students to find the appropriate websites, for example: students complained that the link to link confused them and sometimes they had trouble finding information a second time.

**Recommendations**

Based on the conclusion of this study and the literature on teaching and learning on higher cognitive level, specific recommendations were made for the professors who will teach a web-enhanced course and for students who will take a web-enhanced course.
1. In the teaching and learning process, teachers are advised to initiate and maintain the interest of students by meeting their needs, wants and interests. A need assessment or background knowledge probe, designed to collect specific and useful feedback on students' prior learning, is recommended before conducting a course. Before introducing an important new concept, subject, or topic in the course, consider what the students may already know about it. Teachers should try to find at least one point that most students are likely to know, and use that point to lead into other, less familiar points.

2. There should be a training program or workshop for teachers who will teach a web-enhanced or web-based course. This training should contain: (1) familiarity with the technology, (2) on-line class management skills and (3) pedagogical training such as higher cognitive levels of teaching and the objective classification system. Very few studies have dealt with pedagogical training; however, it is required either from the theoretical or practical point of view.

3. Teachers are recommended to make sure students know about the lesson objectives prior to the start of each lesson. Effective instruction expected student to know what was proposed to teach and what they should learn. Teachers should also always encourage students to be aware of what they are doing and review what they have done in the course.

4. Assignments are always an effective way to encourage students to achieve higher cognitive level of thinking. In this study, out-of-class assignments were assessed
to offer more opportunities for higher order thinking by students than any of the aspects of instruction.

5. An on-line discussion forum is a good way for teachers to observe how students' knowledge was organized and their thinking process through the continuing communication. Bloom (1956) stated that students might answer an analysis or synthesis question by recalling what they heard or read about instead of presenting their own opinions. Gall (1970) stated that teachers' "follow-up" questions and an effective question sequence were needed. Based on the literature, teachers should always ask for a focus and for a reason in any discussion and encourage students to engage actively.

6. The students are recommended to apply the knowledge they learned to their own practical situation. Applications help to inspire higher cognitive levels of reflective thinking.

7. Students are suggested to link to every assigned website and read every assigned on-line article.

8. Students are recommended to check the course website at least once a week to see if there is any new information for the coming class. Doing this make themselves familiar and ready to learn a new topic.

9. To improve communication between teachers and students in the on-line instruction, students are recommend to contact the instructor via e-mail, on-line discussion and chat rooms when they encountered difficulty in understanding course materials.
Implications

Implications for the current body of knowledge

In this study, little difference existed between the distributions of assessed cognitive level of in-class and on-line instruction. However, findings of the study indicated that out-of-class assignments offered more opportunities for higher order thinking by students than both in-class discourse and on-line instruction. This result is similar to the previous studies conducted by Dlamini (1996) in which instructors used assignments to encourage students to apply knowledge in specific situation. In this study, the assignments pushed students to the “creative” level of thinking.

Other than applying and analyzing, students were asked to synthesis and evaluate in the assignments. Ascher (1961) called the teacher “a professional question maker” and claimed that the asking of questions is “one of the basic ways by which the teachers simulate student thinking and learning”. Sanders (1966) stated that good questions recognize the wide possibilities of thought and are built around varying forms of thinking. The data from this study showed that assignments are the most effective way to stimulate higher level thinking. Newcomb and Trefz (1987) stated that when instructors include laboratories, homework, individual or group projects, and term papers, more learning was found at the higher levels of cognition.

In this course, the instructors provided lesson objectives on the web to make students aware of the objectives of each lesson topic prior to each lesson. This corresponds to the recommendation of teaching in higher cognitive level of the study conducted by Whittington (2000).
In order to improve the learning outcomes of students, there should be a training program or workshop for teachers who will teach a web-enhanced or web-based course. This training should contain: (1) familiarity with the technology, (2) online class management skills and (3) pedagogical training such as higher cognitive levels of teaching and the objective classification system. The recommendation about pedagogical development in this study is similar to the conclusions in the literature. Kennedy et al., (1991) stated that there is general agreement in the literature that teachers need to be trained in critical thinking dispositions and skills in order to be able to teach thinking effectively. Truman & Hartman (1998) described that course production is best done when the faculties have taken sufficient time to examine their pedagogical goals. Gall (1970) stated that the lack of effective teacher training programs lead to lower cognitive level instruction.

Recommendations and implications for future studies

1. In this study, the on-line discussion forum was shown to offer more opportunities for higher order thinking. Other than discussion forum, a future study is needed to observe other on-line communication channels between teachers and students, such as chat room or emails.

2. This course was a pedagogical course at the graduate level. The instructor emphasized the principles of teaching and learning and the educational objective classification systems as well. Other courses may produce different results. A future study should examine courses in other areas or at different levels, for
example: technical courses or courses at the undergraduate level, and compare the results across studies.

3. This study needs to be replicated in different settings. A similar study needs to be conducted in a web-enhanced or web-based course in the Extension Education Programs or in the College of Food, Agricultural and Environmental Science.

4. The future study needs to compare the cognitive level of instruction and students’ reflective thinking of courses, which have same course contents and are taught by the same teacher, offered in different settings.

5. A future study should build students’ learning styles into a variable when conducting a similar study. The study will compare the performances of students with different learning styles in a web-enhanced or web-based course.
Appendix A.

The modified Florida Taxonomy of Cognitive Behavior instrument
1. Knowledge

| (1) reads | (2) spells | (3) identifies something by name | (4) defines meaning of term | (5) gives a specific fact | (6) tells about an event | (7) recognizes a symbol | (8) gives steps of process, describe method | (9) names classification system or standard | (10) states generalized concept or idea | (11) states a principle, law, theory | (12) tells about organization or structure | (13) recalls name of principle, law, theory |

2. Translation

| (1) restates brief terms in their own words | (2) gives concrete examples of an abstract example | (3) verbalizes from a graphic representation | (4) translates verbalization | (5) translates figurative statements into literal example & vice-versa. | (6) translates foreign language to English & vice versa. |

3. Interpretation

<p>| (1) gives reason (tells why) | (2) shows similarities/differences | (3) summarizes or concludes from observation of evidence |</p>
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Appendix B

Procedure for administering and scoring a comprehension think aloud
I. Preparing the text

Choose a short passage (expository or narrative) written to meet the following criteria:

1. The text should be from 80 to 200 words in length, depending on the reader's age and reading ability.

2. The text should be new to the reader, but on a topic that is familiar to him or her.

3. The text should be at the reader's instructional level, which can be determined by use of an informal reading inventory. Passages at this level are most likely to be somewhat challenging while not overwhelming readers with word identification problems.

4. The topic sentence should appear last, and the passage should be untitled. Altering the text in this way will elicit information about the reader's strategies for making sense of the passage and inferring the topic.

5. The text should be divided into segments of one to four sentences each.

II. Administering the think aloud procedure

1. Tell the reader that he or she will be reading a story in short segments of one or more sentences.

2. Tell the reader that after reading each section, he or she will be asked to tell what the story is about.

3. Have the student read a segment aloud. After each segment is read, ask the reader to tell what is happening, followed by nondirective probe
questions as necessary. The questions should encourage the reader to generate hypotheses (what do you think this is about?) and to describe what he or she based the hypotheses on (what clues in the story helped you?)

4. Continue the procedure until entire passage is read. Then ask the reader to retell the entire passage in his or her own words. (The reader may reread the story first).

5. The examiner might also ask the reader to find the most important sentence(s) in the passage.

6. The session should be tape-recorded and transcribed. The examiner should also record observations of the child’s behaviors.

III. Analyzing results

Ask the following questions when analyzing the transcript:

1. Does the reader generate hypotheses?

2. Does he/she support hypotheses with information from the passage?

3. What information from the text does the reader use?

4. Does he/she relate material in the text to background knowledge or previous experience?

5. Does the reader integrate new information with the schema he/she has already activated?

6. What does the reader do if there is information that conflicts with the schema he/she has generated?

7. At what point does the reader recognize what the story is about?
8. How does the reader deal with unfamiliar words?

9. What kinds of integration strategies does the reader use (e.g., visualization)?

10. How confident is the reader of his/her hypotheses?

11. What other observation can be made about the reader's behavior, strategies, etc?
Appendix C

Characteristics of the Sample Course and the Teacher
Goals of the sample course

The broad goals of this course are to provide necessary content material and learning skills to enable students to successfully fulfill the educational roles within their professions. The course provides broad exposure to the elements of successful instruction and provides both theory and application. Through reading, discussion, and assigned activities, students will gain the knowledge and skills necessary to facilitate their own development as effective instructors. The intent of the course is to provide the tools necessary so that students can continue on a course of self-motivated learning, instructional development, and self-evaluation.

Strategies of the course

The class consists of lecture, discussion, small group activities, problem-based learning, directed reading, written assignments and self-assessment quizzes. The web site provides some material to help structure students’ learning and additional optional resources for research. Optional resources are provided to help students obtain additional clarification where necessary or allow you to study a particular area in more depth if desired.

Course website

Since it is a web-enhanced course, a course website is available to improve communication and to enhance learning. Students could familiarize themselves with the site and with WebCT by attending the student orientation that was held on the first day of the class and one hour before the formal class time.
The site home page contains a section that will announce all new site materials and class reminders, helpful tips, assignment clarification and other helpful messages. All assignments can be submitted in either hard copy format or via e-mail using MS Word.

About the teacher

During the data collection process, the teacher received the Faculty Award for Distinguished University Service in Spring 2001 at The Ohio State University. This award honors faculty who have made extensive contributions to the development and implementation of University policies and programs through nonadministrative roles.
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