

# 在網路教學環境中探討學生所認知之學習形態與學習活動之關係

## A Study of Learning Styles and Learning Activities Based on Students' Cognition in Web-based Instructional Environments

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### Abstract

The purpose of the study was to explore the relationship between Web-based learning activities and learning styles based on students' cognition in Web-based instructional environments. Participants of the study were Texas A&M University System students who had taken part in a Web-based course during the spring semester of 2005. The sample consisted of 145 participants. Each sample member completed a quantitative survey and answered questions on a Likert-type scale.

The study methodology was based on a quantitative research design. Comparative and descriptive methods were utilized in the study. Collected survey data were analyzed using descriptive and comparative statistics. The purpose of the analysis was to examine the demographic information and the factors influencing student performance. Pearson Chi-square procedure was used to explore the relationships between variables.

Based on the results of the data analysis, the findings in the study include: (1) an indication that the relationships between students' learning styles and Web-based learning activities were shown to be statistically significant for chat room and e-journal activities; (2) the revelation that most study participants preferred visual and kinesthetic/tactile learning styles. The findings provide views, insights, and suggestions for Web-based instructors when developing or designing Web-based learning activities and course materials for more suitable ways and pedagogies in order to help students learn in enhanced Web-based instructional environments.

Keywords: web-based instructional Environments, web-based learning activities, learning styles, web-based courses

### 摘要

近年來，由於科技之發展蓬勃迅速，帶動網際網路之日益活絡，以致使得網路教學儼然已成為教育型態之另一新趨勢。本研究從文獻探討中發現，鮮少有關於網路教學環境中學生所認知之學習形態及學習活動之相關研究，且由於從事網路教學之教師，往往忽略掉網路平台之學習活動及內容設計之重要性，以及缺乏瞭解學生所認知之學習形態和網路平台之學習活動及學習形態之關係，造成學生之學習成效不彰等。因此，本研究之目的是為探討以網路平台之網路教學活動中，學生所認知之網路平台之學習活動與學習形態之關係。

本研究之受測者為 Texas A&M University 之研究所以上學生，這些受測者均曾修過一科以上之網路教學課程，而參與受測者之總人數為 150 人，其中有效問卷為 145 份( $N = 145$ )。受測者依指示回答本研究之量化問卷，而問卷設計係以 Likert scale 之基礎，問卷調查後將所得數據資料，運用 SPSS 統計軟體進行分析。

本研究之方法，是以量化研究為設計基礎，並以描述性及比較性方法，進行分析問卷所得之數據；而描述性分析，是為探討受測者之基本資料(性別、年齡、種族、網路課程之學習經驗)及那些網路平台之學習活動，最為影響學生之學習成效。卡方檢定分析(Chi-square analysis)，則是以比較分析方法，進行探討各個變數之間之關係(網路平台之學習活動及學生學習形態之關係)。

依據問卷數據統計分析之結果及受測者之建議為基礎，本研究之發現包括：

1. 本研究之受測者之學習形態，主要是以「視覺」及「動覺/觸覺」之學習形態佔大多數。
2. 分析網路平台之學習活動及學生學習形態之關係，結果呈現出學生之學習形態、網路討論室( $p = .015 < .05$ )及網路期刊( $p = .030 < .05$ )等活動上，彼此有著顯著性之關係。
3. 在網路平台之學習活動及學生學習形態之關係，分析結果呈現出在網路教學之課程上，不同學習形態之學習者，偏好不同的網路平台之學習活動。

本研究之結果，可提供多方面之觀點與建議，將有助於網路教學之教師或網路平台之學習活動設計者之參考，使其開發及設計網路平台之學習活動及教材時，在網路教學的環境下，能有更多適合學生之網路教學課程活動之設計方法及教學法，以便提昇學生之學習成效。

關鍵字：網路教學環境、網路平台之學習活動、學習形態、網路課程

## A. Introduction

Numerous developers of educational Web-based materials have a tendency to use the Web in conventional ways (Dehoney & Reeves, 1999; Kearsley, 1998). Many teachers have been in disagreement over the requirement for Web-based learning environments that extend the opportunities they offer students (Collis, 1997; Duchastel, 1997). Researchers have directed their scholarship toward learning theories designed to emphasize the need for and value of learning within circumstances that provide active learning and elicit activities for students via the Web.

Rapid advancement of information technology has not only influenced human life, but also the time and space in which humans learn. In the evolving

E-learning environment, both the role of the teacher and their teaching methods should be upgraded correspondingly. Emergence of Web-based learning has brought about numerous challenges to the traditional paradigm of teaching, and at the same time, Web-based learning provides information, resources, and new teaching techniques. Hiltz (1994) stated that the virtual classroom was not only useful for students in school, but the virtual classroom should also become the channel for lifelong learners.

Due to the advancement of computer technology, human learning has broken through the barriers of time and space resulting in the impact of learning styles, learning needs, factors influencing performance, and student satisfaction. These issues should be revisited because of progress made concerning computer technology. E-learning through

Web-based Instruction (WBI) can be used in networking technologies designed to reach all parts of the globe while developing an anytime-anywhere transfer of information and knowledge. Rosenberg (2001) stated that E-learning circumstance contains no time or space constraints, is built with reusable components, and is highly scalable, which means that the same program can be used with 10 participants to 100 participants or even to 100,000 participants with little incremental financial cost or physical effort.

Web-based learning activities vary from playing digital videos in the classroom to completing a semester long, online course through the Internet. E-learning involves various technologies of cable TV, the Internet, or palm-held computers, various forms such as virtual learning, online learning, distance learning, and Web-based learning, and diverse components such as e-book, e-dictionary-library, e-classroom, e-homework, and e-management. Given the complexity of E-learning and, consequently, the diversity in realizing E-learning, there exists various ways of defining E-learning (Huffaker & Calvert, 2003). Large companies, such as IBM, GE, AT&T, and Merrill Lynch use E-learning as one of their main competitive strategies to effectively train employees and distribute knowledge (Rosenberg, 2001; Schank, 2002). Hence, the E-learning study could probe into WBI in both educational and corporate settings leading E-learning through WBI significant progress. In other words, E-learning based on WBI will become an important teaching method in the future.

E-learning through WBI has become a method of student-teacher interaction in learning circumstances. WBI could be a crucial teaching method in education. Ruth and Shi (2001) indicate that distance learning is becoming a main theme in education and in strategical planning for E-learning development. Internet teaching is an alive and burgeoning realm in the United States today. To the college administrator, it is a possible source of an entirely new model for deploying resources for students. Today's technologies utilized in distance learning, the population services, the organizations providing such programs, and the partnerships that have appeared differ in nature and scale from earlier models.

Some of the key components in WBI are the learning styles, performance, and connected satisfaction of students. These key components incorporate factors such as students' interest in the subject, acceptance of the teacher, teaching pedagogies, and course materials. These factors still look critical and valid for today's Web-based learning circumstance, although the actual learning circumstance has changed. There are several important concerns of students using Web-based

learning, such as the choice of subjects that depend on whether they were technology-based, the cost incurred in taking a high-tech subject, and the arguable issue of whether high-tech learning brought back high performance results, which are often overlooked or ignored by researchers. Therefore, the current study explored relationships between Web-based learning activities and learning styles.

## **B. Review of Literature**

Approximately six million adult students would be enrolled in Web-based courses in the 2002 to 2003 academic year (Hons, 2002). Web-based instruction (WBI) is one of several distance learning delivery methods. Created in the Western world, the Internet, the Web, and WBI offer many features that originated from Western pedagogy, ideology, and culture (Cahoone, 1998; Thurber, Pope & Stratton, 1995). Dow (2003) stated that postsecondary instructors require WBI information related to electronic instruction designed to build a course that will be both helpful and positively perceived by instructors and students. According to Sage (2000), WBI is increasingly being acknowledged as a means of instruction and learning. Web-based technology can be used as a powerful tool for locating and organizing information and as a means of delivering and presenting Web-based material. Using the Internet can be considered a method of searching for information or targeted hunting for specific information.

Diaz and Cartnal (1999) first compared the learning styles of Web-based learners with on-campus students. Forty online students and sixty-three on-campus students participated in the survey of the Grasha-Reichmann Student Learning Styles Scale in the study. Each group was enrolled in health education classes that employed the same textbook, syllabus, and course content. Employing a two-tailed t-test, the researchers determined that the difference in Grasha-Reichmann Student Learning Styles Scale scores between the groups was not due to chance ( $p < .05$ , and  $p < .01$ ). In the study, these results indicated that the on-campus group wanted to exceed the expectations of the syllabus. Web-based learners were more independent and less collaborative than on-campus learners.

When comparing WBI with traditional methods of instruction, WBI has many advantages which traditional instruction does not provide. For example, Web-based tools supply unlimited time, serve students over a wide area, and provide plenty of information and knowledge at the same time in technology functions. Given the convenience of WBI, it appears Web-based methods will become a critical

teaching tool in the future. As a result of WBI's popularity, instructors need to encourage the use of Web-based tools when designing course syllabi in order to attract the interests of students and increase the probability of improved student engagement.

### 1. Learning styles

Sarasin (1999) states that "a learning style is basically the preference or predisposition of an individual to perceive and process information in a particular way or combination of ways. Learning styles can be analyzed and understood in various ways. Learning may be analyzed and understood according to the primary sense involved- visual, auditory, tactile or kinesthetic or according to psychological aspect of perception or according to the method of processing information" (p. 3). Rasmussen and Davidson-Shivers (1998) find that learning styles can be a crucial variable in cognitive information procedures. Ross and Schulz (1999) state that using the World Wide Web would accommodate various learning styles of both teachers and their students.

Guild (1997) recommends that instructors who are concerned with learning styles "bring an approach and attitude to their teaching by focusing on how students learn and the unique qualities of each student" (p. 30). Tomlinson (1996) report that an importance is placed on the teacher to be aware of the learners' styles, and adapting teaching styles and instructional materials to meet student needs. According to Tomlinson:

We must move ... towards creating an appropriate learning environment, concentrate on better understanding how people learn so that they can be better helped to learn ... redesigning the very processes of learning, assessment and organization so as to fit the objectives and learning styles of students (p. 4).

Identifying learning styles and instructional content alone fails to achieve effective teaching.

Jensen (1996) recommends that in order to adapt to the variety of learning styles, effective teaching has to involve all human senses while addressing the learner needs in a variety of learning activities. Lynch, Woelfl, Steele, and Hanssen (1998) state that:

To determine if learning styles correlate with objective multiple-choice and clinical measures of performance, the learning styles of third-year medical students (n= 227) were evaluated using the LSI. Performance was assessed using the United States Medical Licensing Examination step 1 (USMLE 1),

the National Board of Medical Examiners (NBME) multiple-choice surgical subject examination (MCQ), and NBME computer-based case simulations (CBX). This paper proposes to investigate the relationship between learning styles, as determined by Kolb's Learning Style Inventory (LSI), and various measures of academic performance in two cohorts of third-year medical students (p. 63).

Teaching and learning are a transactional process. As such, Swisher (1994) indicates that learning styles could influence instructors' teaching. If instructional environments could be developed for students of a different learning style, instructional environments would help learning efficiency and effort. Instructors should use different instructional pedagogies to accommodate diverse learning styles. Brownfield (1993) says that knowledge of learning styles could help instructors realize and appreciate individual differences among students. Prior to Brownfield (1993) and Davidson (1990), recommended that learning styles were ways in which humans gathered and processed information, not including the manner in which learners preferred to learn. O'Brien (1994) found that much attention had been directed to the significance of learning styles in education. Many differences between learning styles and Web-based learning styles are obvious. Web-based learning styles enhance convenient learning through an electronic instrument and the concept of personal self-managed learning that appeals to students.

James and Gardner (1995) defined a learning style as the "complex manner in which, and conditions under which, learners most efficiently and most effectively perceive, process, store, and recall what they are attempting to learn" (p. 20). In addition, Merriam and Caffarella (1991) explained Smith's definition of learning style, which is popular in adult education, as the "individual's characteristic way of processing information, feeling, and behaving in learning situations" (p. 176). Later, Swanson (1995) employed Reichmann's reference to learning style as a special set of behaviors and attitudes about the learning context and also explains Keefe's definition of learning style as "the cognitive, affective, and physiological factors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" (p. 2). In their explanations, these definitions have understandable variations as they tend to reflect the perspectives of different learning style inventories.

#### (1) Sarasin's Learning Styles

Sarasin (1999) states the learning needs of the

students, taking into consideration individual preferences for incorporating and keeping course material in an auditory, visual, or tactile/kinesthetic mode. Three features of auditory, visual, and tactile/kinesthetic learners are, along with suitable instructional manners, student reactions to the learning style and the appraisal of each learning style. Caudill (1998) states that all students learn in different ways; therefore, varying the instruction methods to contain the three basic learning styles (auditory, visual, and tactile/kinesthetic) in instructional presentation is necessary to match student needs. Students favor different learning styles or combinations of multiple learning styles, so Web-based or online instructors should develop learning activities that address students' focused method of learning to provide significant experiences for each student or learner. In designing Web-based courses, this best can be achieved by employing multiple instructional tactics. Figure 1 is a flowchart of the learning styles in Sarasin's theory learning styles. Her descriptions reflect different types of perception, including seeing, hearing, and touch/moving and are as follows:

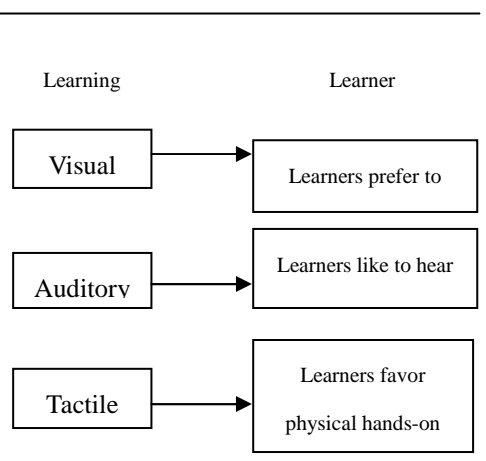


Figure 1 Sarasin's Model of Learning Styles  
 Note. Adapted from Sarasin, L.C., 1999, Learning Style perspectives

Sarasin (1999) addresses student learning needs from a perspective of learner auditory, visual, or tactile/kinesthetic preference. An auditory learning style student requires information that is presented orally. Auditory learners imagine abstractly and learn to be sequential, reflective, analytical, and cognitive by nature. On the side of pre-instructional tactics for auditory learners, the learning requirements of the auditory learners are verbal questioning or focusing. Content of the instruction is employed by asking questions and providing an oral focus for aiding students' learning. Lecture, discussion, presentation, and questioning skills are four instructional strategies containing specific answer activities that need to be

employed by voice or sound.

A visual learner requires that instructional information will be presented by graphics or diagrams. Visual learners possess characteristics which are holistic, random, global, mental, and substantial. Visual learners like to study a concept wholly before attempting to understand the graphics or diagrams' parts. For pre-instructional tactics for auditory learners, instructors need to fit the requirements of visual learners to focus on writing. Instructors can employ visual information of the lesson or activities on the bulletin board in the form of a visual guideline or outline. Instructors can create a visual learning opportunity in order to assist student learning.

A tactile/kinesthetic learner studies by touching or feeling course materials. Tactile/kinesthetic learners depend on physical interaction and need activity interaction to realize completely new knowledge during the learning procedure. Instructors can make a learning environment for tactile/kinesthetic learners to interact physically with course materials. A "hands-on" opportunity permits tactile/kinesthetic learners to concentrate on the intent of the course materials that will be important to learning. Tactile/kinesthetic learners require instructors to design course activities to provide an extended chance to practice and learn in the classroom. According to Sarasin's learning styles, the learning styles and Web-based learning activities of this study would employ auditory, visual, and tactile/kinesthetic learning styles to probe into how suitable the Web-based instructional environment for online students can be applied in WBI.

## 2. Web-based Learning Activities

Northrup (2001) noted that the nature of Web-based learning activities is to learn anytime and anywhere, empowering the student with inflexible schedules to enjoy flexibility. Group study, teamwork, and collaboration are assigned to overcome the sense of separation. By the end of the 1990s, activities of Web-based instruction had already become a crucial form of college course delivery (Katz, 1999). Schools, universities, and corporations were scrambling to supply more and more teaching and training on the Web (Bannan and Milheim, 1997). Oliver (1999), creating Web-based learning environments on the World Wide Web, attempted to describe a framework that identifies components required in the design of Web-based learning: (1) course content, (2) course materials, (3) learning activities, and (4) learning supports.

Two years prior to Oliver's work, however, Goggin, Finkenberg, and Morrow (1997) describe the

“pedagogical unknowns” of Web course organization, Web-based instructional tactics, and the logistics of E-learning. Computer networks supply educators with more instruments and pedagogies for reaching more students and aiding learning (McIsaac & Gunawardena, 1996). While extending the scholarship since 1996, Sarasin (1999) reports the following:

The process for implementing the teaching strategies that have been developed is threefold. First, we must understand our students and their learning needs. Second, we must take the time to know and understand learning styles research and apply the specific strategies that are appropriate for our students and their situation. Last, we must be committed to continually plan with individual learning styles in mind and to continually use strategies that address the learning styles of our students, modifying those strategies as individual learning needs change (p. 92).

Clearly, these in the era for Web-based learning have analyzed the public needs and were charged with the task of meeting needs, such as providing a flexible schedule and a good Web-based tool design for learners. Web-based instructors require understanding online students’ needs and creating Web-based course activities along with materials to meet teacher or student needs. Duchastel (1997) recommended a continuum that assists an instructor to extend the face-to-face classroom model to one better suited for electronic procedures and global resources.

Hiltz (1994) and Jonassen, Previs, Christy and Stavroulaki (1999) noted that Web-based courses that provided various kinds of Web-based interaction were compared with traditional courses as to their usability in a number of studies. Moore and Kearsley (1998) supplied the differentiation among three kinds of interactions of Web-based courses: learner-content, learner-teacher, and learner-learner interaction. Students prefer to learn anytime, anywhere, and with a flexible schedule in Web-based courses. In their findings, these kinds of interactions can occur either synchronously and asynchronously. Web-based instructional pedagogy is defined as learning activities that are interactive and require student participation. Web-based learning activities include threaded discussions, current themes or event chat rooms, Web-based research, Web-based case studies, and participation on a mandated number of e-mail or Web-based contacts per week. Some researchers have addressed particular issues associated with WBI, including preparation of materials (Landis, 2000), the incorporation of interactivity (Liaw & Huang, 2000),

and pedagogical considerations (Bonk & Reynolds, 1997).

Hiltz (1994) and Simich-Dudgeon (1998) view the Web as a worldwide, efficient, and interactive technology for delivering instruction, learning activities, outlined technical features of WBI, and providing particular criteria for the Web-based learning activities. WBI in the Internet and the Web were designed to be distance and time independent instruments that students could access on the Internet or the Web from virtually any location by using any computer platform and at any convenience to learners. Technology today also offers an open system in which learners are not restricted to a classroom type of circumstance but are free to probe into the resources provided by the Internet and are encouraged to participate in never-ending discussions and online learning activities (Khan, 1997). Romiszowski (1997) suggests small-group discussions, simulation games, project-based studies, and collaborative problem-solving as possible online activities. All of these learning activities can be employed in Web-based courses.

In addition to courses in nursing, Zolkos (1999) probed into the insurance industry's move to supply more certification courses via Web-based courses. Most of the students are non-traditional students, meaning the learners do not have the time to dedicate to traditional learning circumstances. Unlike traditional classroom meetings, the flexibility of the Internet provides an attractive alternative for full-time employees with family to time manage more efficiently. Web-based students with inflexible schedules found the web courses to be a positive experience. Furthermore, the participants noted that the ability to interact with their counterparts from all across the nation was an added benefit. One of the ways Web-based courses utilize technology is through the use of the World Wide Web. Gagne and Shepherd (2001) announce that interacting with the instructors and students is somewhat impeded in Web-based courses. Ryan (2000) states that “interaction with the online instructors using e-mail, telephone, or chat demands greater efficiency that opens oral discussion, and therefore is more limited. WBI is perhaps the greatest limitation of the online delivery method. Almost all online participants felt that this was the greatest weakness of the class.”(p. 82). Consequently, Web-based instructors need to overcome these barriers in online education.

In addition to the barriers associated with online education, Paulsen (1995) provides four types of activities for a computer-mediated communication circumstance: (1) one-alone, (2) one-to-one, (3)

one-to-many, and (4) many-to-many interaction and learning activities. Technology-enhanced communication permits threaded discussions so that problem solving can be broken into tasks. Moore (1993) and Moore and Kearsley (1998) provided the characteristic between three types of interaction: learner-content, learner-teacher, and learner-learner interaction, which can happen either synchronously or asynchronously via Web-based instructional circumstances. The benefit of Web-based learning is unlimited learning activities in time and space.

Discussing the technical characteristics of the Web alone does not help illustrate how the Web as a medium interacts with the pedagogical process associated with WBI. Web-based learning activities are necessary to probe how the Web is used to support both the instruction and the learning processes in an environment of WBI. In order to explore pedagogical characteristics of WBI, Bunker (1998) and Grabinger (1996) found that active learning circumstances not only provide learning that is transferable and applicable to real-world circumstances, but these scholars insist that students be “active constructors” of knowledge through the process of self-discovery and the facilitation by experts and mentors in the field. An active learning circumstance epitomizes learning that is interactive, student-centered, contextualized, exploratory, reflective, intentional, and collaborative (Savery & Duffy, 1995). Likewise, Fortune, McCarthy, and Abramson (2001) assert that “different learning activities should contribute to student learning” (p. 113).

### C. Methodology and Data Analysis

McCormack & Jones (1998) ascribed the limited use of the Web in instruction to the following causes: (1) knowledge and (2) resources. A limited number of instructors have the knowledge of technical and educational rules required in building Web-based instruction (WBI). The study attempted to probe into what kinds of Web-based learning activities were associated with the relationship between Web-based learning activities and learning styles. WBI provides an additional selection to pedagogy for students who are unable to attend classes on a university campus. Students can attend learning activities through WBI without being present on campus. The study assisted Web-based instructors in creating the Web-based learning activities and pedagogical tools most suitable for students. These Web-based learning activities and pedagogical tools would convert the unengaged, at-risk student to an engaged, lifelong learner.

#### 1. Research question and null hypothesis

One research question guided the study:

What is the relationship between Web-based learning activities and student learning styles?

In the study, the following null hypothesis was examined by analyzing the survey data of the research:

H<sub>01</sub>- There is no significant relationship between student learning style and rates of response for preferred Web-based learning activities.

#### 2. Research Methodology

The study utilized quantitative research methods. A quantitative instrument analyzed with descriptive and comparative methods were used to examine the relationship between learning styles and learning activities based on students' cognition in the Web-based instructional courses. Quantitative research is based on things that are in a certain quantity and can be measured. “While Thorndike's statement from 1904 appears to be fairly innocent and direct, it is an important philosophical position that has persisted in social science research throughout most of this century” (Custer, 1996, p. 3). Quantitative research is all about quantifying the relationships between variables. Independent variables in the study are Web-based learning activities. In the study, the analysis method utilized various pedagogical stances, which exist for the research needs in statistics.

Quantitative research in the study examined the relationship between Web-based learning activities and learning styles based on students' cognition in Web-based instructional environment. The quantitative goal was to detect the relationships between Web-based learning activities and learning styles. In the study, descriptive and comparative statistics were used to analyze the survey data. The one null hypothesis was tested to explain the research questions in this study. The null hypothesis explored the significant relationship between student learning style and rates of response for preferred Web-based learning activities.

#### 3. Research Design

Participant selection was determined through Web-based instructional courses offered by the Texas A&M University System at the graduate level during the 2005 spring semester. Subjects were groups constructed from students in graduate level courses. Each participant had taken at least one Web-based class used in the Web-based instructional environment. Web-based instructional courses were performed by the Web-based instructional courseware,

such as WebCT or other course management courseware. Approximately 150 participants completed a quantitative instrument of the *Learning Style Questionnaire of Web-based Learning Activities*.

Quantitative research is the numerical representation and operation of observations for the purpose of characterizing and explaining the phenomena that those observations reflect. A quantitative method in the study was employed to create the survey of the *Learning Style Questionnaire of Web-based Learning Activities* to examine the relationship between learning activities and learning styles (auditory, visual, and kinesthetic/tactile) based on students' cognition in Web-based instructional courses, which were used as methods of statistical analysis. A quantitative questionnaire of the study employed the survey of the *Learning Style Questionnaire of Web-based Learning Activities*. In the study, the survey was developed to probe into Web-based learning activities and learning styles based on students' cognition in Web-based instructional environments. Then, the study provided suggestions and recommendations to instructors who were teaching classes through Web-based instructional environments.

#### 4. Subjects of the Study

The study employed a questionnaire using Likert-type scales for data collection. Moore and Kearsley (1998) state the need for realizing learners' characteristics in distance education. The *Learning Style Questionnaire of Web-based Learning Activities* was employed to collect data as reflected in the instrument of the study. Part I of the instrument was the demographic information instrument including age, gender, and ethnicity, which was employed to collect data via the survey of participants' general characteristics. Part II of the form was employed to collect the specific learning experience in Web-based learning activities. Finally, Part III collected students' experience in Web-based learning activities and learning styles (auditory, visual, and kinesthetic/tactile) based on students' cognition in Web-based instructional courses.

A *Learning Style Questionnaire of Web-based Learning Activities* instrument created by the researcher included 25 questions measuring learning styles and Web-based learning activities based on students' cognition in Web-based instructional environments. Homepage links of Web-based surveys were e-mailed via Microsoft Outlook in the Texas A&M University System. Fifty-five paper-based surveys were handed directly to graduate students enrolled at the Texas A&M University-Kingsville.

Participants took the survey via Internet and/or hardcopy surveys. The online survey data were automatically sent to the database server of the survey homepages. The hardcopy surveys were returned to the researcher when participants finished the surveys. The researcher checked the returned rates of the surveys from participants who had replied to the survey and had followed up by sending reminders to participants who had not.

#### 5. Instrumentation

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#### 6. Procedures

Procedures for processing and coding the data were reviewed. A demographic information form was sent to each study participant. Each participant responded to the survey at the end of semester in Web-based courses. Each participant was requested to read and check the demographic information form



before responding to the survey. Quantitative research procedures of the data collection provided quantitative results. The surveys were administered to students taking WBI courses, and the action strategy is providing interesting Web-based learning activities to probe into learning styles.

### 7. Data Collection and Recording

Data were collected using the quantitative survey to investigate the factors the relationship of Web-based learning activities on learning styles within Web-based instructional environments. A quantitative approach to collect data was utilized in the study. In data collection, the *Learning Style Questionnaire of Web-based Learning Activities* instruments were used on the Web-based courses via WebCT or other course management courseware.

Data collection occurred at the conclusion of each course through administration of the survey to students in selected classes. Data were obtained via a Likert Scaled instrument. Data were analyzed through use of the Statistical Package for Social Sciences (SPSS). Furthermore, the respondents recorded their demographic information and their Web-based course experience on the survey. Data were recorded quantitatively from the 5-point Likert-type scale questionnaire.

Record keeping in the study provided a means of effectively managing records by developing practical methods and solutions for capturing records, registering records, deciding how long to keep records, categorizing records, accessing records, keeping records, and disposing of records. In the study, demographic information and survey data were crucial to the data collection process. Survey results and demographic information of participants were maintained in a confidential manner. The documents were preserved.

### 8. Data analysis

For data analysis, the variables that represented learning styles and learning activities based on students' cognition in Web-based instructional environments were examined. The three variables included learning styles and learning activities, which were computed employing the *Learning Style Questionnaire of Web-based Learning Activities*. A model for data analysis included Web-based learning activities which are represented as follows:

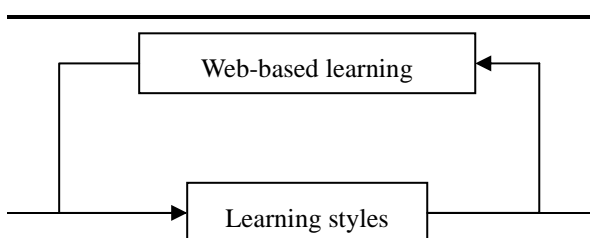


Figure 2. Model for Data Analysis

Norusis (2004) states that statistics involve collecting, classifying, summarizing, organizing, analyzing, and describing data. In the study, the data of the survey were analyzed by descriptive and comparative statistics utilizing the Statistical Package for the Social Sciences version 12.0. Quantitative research employed an analysis of comparative and descriptive procedures designed to explore the data and compute descriptive and comparative statistics for each variable in the study.

Frequency distributions with histograms and descriptive statistics (mean, median, and standard deviation) were employed to describe the characteristics of shape or distribution. Second, the individual Likert-type items were analyzed for their individual differences. Chi-square (Pearson Chi-square) tests were employed to examine and describe the distribution of observed counts for the survey in this study.

Chi-square is often employed to appraise the relationship between an obtained set of frequencies in a random sample. Hence, the study employed Chi-square to explore the relationships between the variables. Chi-square is a non-parametric statistical test to decide whether research data in the form of frequency counts are equally distributed for samples (Gall et al., 2003). A calculated value of Chi-square compares the observed frequencies of various categories of items in a random sample to the expected frequencies that are intended if the null hypothesis was true.

Chi-square was used to analyze and compare each questionnaire item in conditions of Web-based learning in this study. Cross tabulation tables and the statistic Chi-square (Pearson Chi-square) were employed to explore whether a relationship exists among variables. In the analysis method, Chi-square attempted to analyze the students who attended Web-based learning activities through Web-based instructional environments to compare the frequency and the relationship of learning styles and Web-based learning activities in the conditions of Web-based courses. Chi-square was applied to measure the relationships between Web-based learning activities and learning styles (auditory, visual, and kinesthetic/tactile).

#### (1) Demographics of Participants

For statistical data analysis, descriptive and

comparative statistics were calculated for each section of participant demographics. The statistics were computed and multiple tables were produced to present the findings. The first part of the survey instrument consisted of demographic data. In this part of document, every participant was required to provide personal information necessary to produce variables pertinent to the study. The information included age, gender, ethnicity, number of Web-based courses taken, and Web-based course semesters taken.

Table 1 *Descriptive Statistics for Age Variable by Gender, N = 145*

Variable	M	SD
Age-Total Sample	37.14	9.73
Males	39.15	8.66
Females	36.18	10.10

A total of 145 students completed the age related section in the study. Table 1 shows descriptive statistics for mean and standard deviation of students by age. The mean for the participants' age was 37.14 and the standard deviation was 9.73. In addition, the mean for the male participants' age was 39.15 and the standard deviation of the male participants' age was 8.66. The mean for the female participants' age was 36.18 and the standard deviation of the female participants' age was 10.10. The result showed the average age of the female participants was younger than the average age of the male participants.

A total of 144 students completed the survey section related to gender. Table 2 shows descriptive statistics for the percent of the participants by gender. Females contributed the greatest number of responses. There were 46 male students and 98 female students who responded to the questionnaire. The survey sample was comprised of 67.6 percent female students, 31.7 percent male students, and 1 missing response for the question (.7%). As a result of the data analysis, it was determined that the population of the female participants was double the population of male participants.

Table 2 *Descriptive Statistics for Gender Variable, N=145*

Variable	N	Percent (%)
Male	46	31.7
Female	98	67.6
Missing value	1	.7
Total participants	145	100.0

As shown in Table 3, there were 49 (33.8%) White American students, 5 (3.4%) Black American students, 74 (51.0%) Hispanic American students, 2 (1.4%) Asian American students, 1 (.7%) Native American student, and 11 (7.6 %) students of other ethnicity. Three (2.1%) of the participants did not respond to the question. Hispanic American students were the major ethnic group in the study. They exceeded one-half of the survey population. In all, the composition of the participants' cultural background showed the diverse ethnicity of students in Web-based classes in the Texas A&M University System.

Table 3 *Descriptive Statistics for Ethnicity Variable, N = 145*

Variable	N	Percent (%)
White American	49	33.8
Black American	5	3.4
Hispanic American	74	51.0
Asian American	2	1.4
Native American	1	.7
Other	11	7.6
Missing values	3	2.1
Total participants	145	100.0

Survey participants were required to meet one conditional requirement, which was that participants had to have previously taken at least one Web-based class. As shown in Table 4, 43 students (29.7%) have taken one Web-based class. Twenty-two students (15.2%) have taken two Web-based classes. Twenty-four students (16.6%) have taken three Web-based classes. Twenty-two students (15.2%) have taken four Web-based classes. Thirty-two students (22.1%) have taken five Web-based classes. Two students (1.4%) did not provide a response to this question. All participants had taken at least one Web-based course and students who had taken only one course were the major group in the study. The average number of the Web-based courses was 2.85. In other words, each participant had taken an average of 3 courses and possessed a great deal of experience in taking Web-based classes.

Table 4 *Descriptive Statistics for Experience of Students in Web-based classes, N = 145*

Web-based Course	N	Percent	M	SD
One course	43	29.7		
Two courses	22	15.2		
Three courses	24	16.6		

Four courses	22	15.2		
Five or more courses	32	22.1		
Missing values	2	1.4		
Total	145	100.0	2.85	1.55

(2) Variable Analysis of Instrument

A variable analysis was conducted to explore each test variable for normality and accuracy. That was accomplished by computing descriptive statistics. Frequency distributions were employed to explore the descriptive statistics (mean or median, standard deviation) and to identify the characteristics of the variables in the study. The Likert scale ranged from 1 (strongly disagree) to 5 (strongly agree) and a score of 3 indicated a neutral response in the learning styles section. The median answers of the 23 Likert-type questionnaire items are shown in Table 5.

In the study, the Likert-type scale is an ordinal scale unit of measurement characterized by order and classification, which measures differences in scale. Green and Salkind (2004) indicated that measures of central tendency include the mean, the median, the middle value of ranked scores, the arithmetic average of a set of scores, and mode. Furthermore, median is the exact midpoint of any distribution and is a much more accurate representation for central tendency than the mean.

As shown in Table 5, the median represented the central tendency of each question in the survey. The ten items in the learning style section had a median score of 4, which represented an answer of “agree.” The five items in the learning style section had the smallest sample median which was 3, representing an answer of “neutral.” The results of the data analysis showed that the major response from participants was “agree” in the learning styles section. In other words, the results showed that most participants agreed with Web-based classes, respectively, in the learning styles’ section.

Variable	Item Description	Median Answer
Auditory03	Prefer voice feedback	3
Auditory04	Voice information helps me	3
Auditory05	Prefer to communicate	3
Visual01	Like visual feedback	4
Visual02	Diagrams and charts help me	4
Visual03	Photos attract my attention	4
Visual04	Like to use diagrams and charts	4
Visual05	Enjoy reading graphic content	4
Kinesthetic/tactile01	Prefer interaction learning	4
Kinesthetic/tactile02	Interactive activities help me	4
Kinesthetic/tactile03	Material with manipulative component	4
Kinesthetic/tactile04	Prefer typing words	4
Kinesthetic/tactile05	Use chat rooms to communicate	4

As shown in Figure 3, most participants’ learning style was visual when they studied in Web-based classes. The auditory learning style was least preferred by response. The visual learning style was followed by the kinesthetic/tactile learning style and multiple learning styles.

Table 5 Median Answers for the Single Likert-Type Questionnaire Items

Variable	Item Description	Median Answer
Auditory01	Like sound message	3
Auditory02	Sound attracts my attention	3

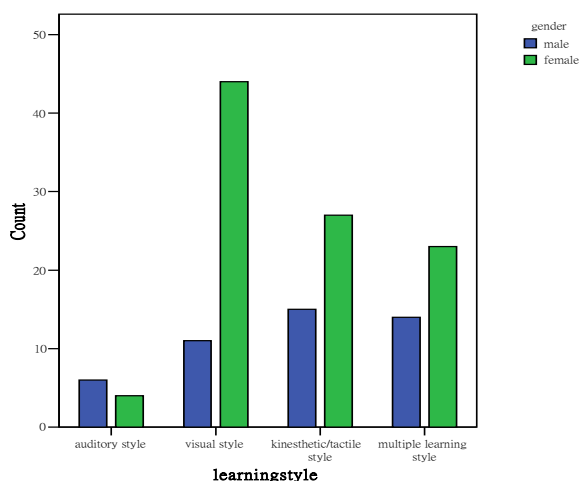


Figure 3. Distributions of the Learning Styles by the Participants

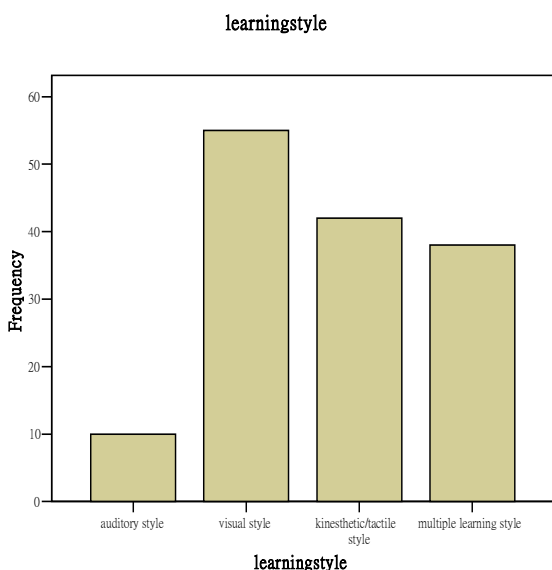


Figure 4. Distributions of the Learning Styles by the Participants' Gender

As shown in Figure 4, most female participants' learning style was visual when they studied in Web-based classes. Female participants were least likely to prefer the auditory learning style. For both males and females, the number of participants preferring the auditory learning style was less than the number preferring multiple learning styles. The preference of female participants exceeded the preference of male participants in visual learning style, kinesthetic/tactile learning style, and multiple learning styles. Male participants, however, had a greater preference for the auditory learning style than did female participants. Additionally, the preference distributions of the female participants' learning styles were contrary to the learning style preference

of males. Overall, the preferred learning styles of the female participants were visual, while the learning style preferred by the male participants was kinesthetic/tactile.

### (3) Questionnaire

Questions seven to twenty-two in the instrument examined the relationship between Web-based learning activities and student learning styles. The students' learning styles (LS) in the study were defined using the following questions in the indicated sections:

#### *Auditory Style Section*

- a. I like sound messages in Web-based classes. (LS1)
- b. Sound messages attract my attention in Web-based classes. (LS2)
- c. I prefer to receive voice feedback in Web-based classes. (LS3)
- d. Voice information helps me to remember knowledge in Web-based classes. (LS4)
- e. I prefer to communicate with instructors and classmates orally. (LS5)

#### *Visual Style Section*

- f. I prefer to receive visual feedback in Web-based classes. (LS6)
- g. Diagrams and charts help me remember new information. (LS7)
- h. Photos messages attract my attention in Web-based classes. (LS8)
- i. I like to use diagrams and charts to express my ideas to instructors and classmates in Web-based classes. (LS9)
- j. I enjoy reading the graphic content on discussion boards or e-mail in Web-based classes. (LS10)

#### *Kinesthetic/ Tactile style Section*

- k. I prefer interaction learning when involved in Web-based learning activities. (LS11)
- l. Interactive learning activities help me to understand knowledge in Web-based classes. (LS12)
- m. Course materials with manipulative components attract me when I learn. (LS13)
- n. I prefer typing words for my assignment in Web-based classes. (LS14)

- o. I use chat rooms to communicate with my professors and classmates in Web-based classes. (LS15)
- p. Which of the following Web-based learning activities (LA) do you like, feel neutral about, or dislike in Web-based courses? (LA1)

Preferences about Web-based learning activities were assessed using a separate checklist table (Table 6).

Table 6  
*Web-based Learning Activities List for Students' Like Levels*

L	N	D	Activities name	L	N	D	Activities name
			Discussion board				Online examinations
			Chat room				Watching video clips
			Case study				Online presentation
			E-mail				Links to online resources
			E-journal				Online survey
			Exploring homepage				other
			Group assignment				
			Individual assignment				
			Online quizzes				

The score in the survey for the Likert-type scale questions LS1, LS2, LS3, LS4, LS5, LS6, LS7, LS8, LS9, LS10, LS11, LS12, LS13, LS14, LS15 ranged from a 1( Strongly Disagree), 2 (Disagree), 3(Neutral), 4(Agree), to 5 (Strongly Agree). To determine the preferred method of the learning style, it was necessary to compute the highest total scores from participants' responses in each part (auditory style, visual style, and kinesthetic/tactile style) and then to correspond the highest total score that represented the participants' learning style. The total score of the auditory style in each participant response was the sum of LS1, LS2, LS3, LS4, and LS5. The total score of the visual style in each participant response was the sum of LS6, LS7, LS8, LS9, and LS10. The total score of the kinesthetic/tactile style in each participant response was the sum of LS11, LS12, LS13, LS14, and LS15. To analyze the data, each part was reviewed individually. In other words, if the responses of a

participant had the highest sum score in the visual style part that participant's preferred learning style was determined to be visual. The method for judging the other learning styles was the same. The learning styles were divided into the four categories that included auditory, visual, kinesthetic/tactile, and multiple learning styles. Multiple learning styles indicated that identical sum score appeared in two or more learning style categories.

One survey table related to learning activities (LA). The scores for the table ranged from 1(Dislike), 2 (Neutral), to 3 (Like). The participants had to select the scale from a given range for each item. The response scores of the participants in each activity were totaled. In addition, eight participants proposed comments for "other" activities. The eight comments from the Web-based survey were as follow:

Web Based Video, Cameras, PowerPoint Producer, Snag it (Respondent #64, female)

The only thing is that most of the professors who teach web courses expect you to already know a lot about technology and expect you to automatically be an expert. I thought classes were given so that students can learn how to become good. I think more interaction with professors and this type of understanding is needed in these web courses. (Respondent #65, female)

If possible, I prefer to be in a classroom environment, however, when I do enroll in a web-course it is usually for efficiency. I like to receive a syllabus, instructions, expectations, and a timeline in order to complete the necessary requirements without spending unnecessary time in chat rooms/discussion boards. (Respondent #83, female)

None. I do have a hard time with printing from on-line communications when the professor doesn't know what she is doing! (Respondent #98, female)

When the resources do not work! (Respondent #104, female)

Satisfaction with online learning comes from how open and willing the students are to communicating in an online environment. It's easy to make statements like, "I agree ..." and not add any depth to the conversation. Also, I have found many people find it easy to make excuses for not participating fully in collaborative work and/or performing poorly in collaborative work groups. (Respondent #111, female)

I enjoy the easy load that an online course provides, but they can be somewhat confusing.

(Respondent #123, male)

Too much money is paid for the course and often times the learning obtained is less than the actual sit in session with the instructor...a sincere opinion....it is attractive because of convenience and not necessarily the “learning content” and preparation it offers the student....it should “enhance” the instruction in the university class; not replace it!. (Respondent #130, female)

Through suggestions and comments, participants offered their opinions and explained why they liked or disliked using Web-based learning activities in Web-based classes.

In the study, the following null hypothesis was examined by analyzing the survey data to respond to research question two.

H<sub>01</sub>- There is no significant relationship between student learning style and rates of response for preferred Web-based learning activities.

The first process in examining the above quantitative hypothesis was a two-way contingency table analysis using crosstabs (Pearson Chi-square), which dealt with each of the four learning styles and each of fifteen Web-based learning activities to examine their relationships. Learning style (with 4 levels) was the independent variable and each of the Web-based learning activities was the dependent variables in the Pearson Chi-square procedures. On the whole, the four learning styles were run against the responses for each of the fifteen Web-based learning activities to explore their relationships.

As shown in Table 7, the prevalence of agreement with Web-based learning activities among student learning style groups showed the level of preference of the participants among the four learning styles that are auditory style, visual style, kinesthetic/tactile style, and multiple learning styles. The Chi-square values for judging the significance of the relationship of the learning styles and Web-based learning activities were included in Table 8. The participants of auditory learning style most liked the activity of group assignment (12.8%) except the “other” activity. The participants with a preference for visual learning style most liked the activity of e-journal (44.7%). The participants with a preference for kinesthetic/tactile learning style most liked the activity of chat room (40.0%). The participants with a multiple learning styles most liked the activity of e-journal (31.9%).

In addition, the participants preferring an auditory learning style most disliked the activity of links to online resources (28.6%). The participants preferring

a visual learning style most disliked the activity of individual assignment (100.0%). The participants preferring a kinesthetic/tactile learning style most disliked the activity of exploring homepage (57.1%). The participants preferring a multiple learning styles most disliked the activity of online presentation (48.1%).

Table 7 Prevalence (%) of Agreement (Like (L)) and Disagreement (Dislike (D)) with Web-based Learning Activities Among Student Learning Style Groups, N=145

Activities	Auditory Style	Visual Style	Kin/Tactile	Multiple Styles
Discussion board	7.3(L)	40.2(L)	28.0(L)	24.4(L)
	5.3(D)	31.6(D)	26.3(D)	36.8(D)
Chat room	8.6(L)	27.1(L)	40.0(L)	24.3(L)
	8.0(D)	48.0(D)	8.0(D)	36.0(D)
Case study	8.9(L)	35.6(L)	28.9(L)	26.7(L)
	7.1(D)	28.6(D)	28.6(D)	35.7(D)
E-mail	7.8(L)	36.2(L)	30.2(L)	25.9(L)
	0(D)	50.0(D)	25.0(D)	25.0(D)
E-journal	6.4(L)	44.7(L)	17.0(L)	31.9(L)
	23.1(D)	46.2(D)	7.7(D)	23.1(D)
Exploring homepage	7.4(L)	39.7(L)	27.9(L)	25.0(L)
	14.3(D)	14.3(D)	57.1(D)	14.3(D)
Group assignment	12.8(L)	25.5(L)	36.2(L)	25.5(L)
	6.4(D)	44.7(D)	17.0(D)	31.9(D)
Individual assignment	4.9(L)	37.3(L)	27.5(L)	30.4(L)
	0(D)	100.0(D)	0(D)	0(D)
Online quizzes	9.1(L)	34.5(L)	30.9(L)	25.5(L)
	6.5(D)	45.2(D)	25.8(D)	22.6(D)
Online examinations	7.4(L)	35.2(L)	31.5(L)	25.9(L)
	5.6(D)	41.7(D)	25.0(D)	27.8(D)
Watching video clips	6.8(L)	41.1(L)	28.8(L)	23.3(L)
	18.2(D)	27.3(D)	27.3(D)	27.3(D)
Online presentation	6.9(L)	39.7(L)	36.2(L)	17.2(L)
	7.4(D)	25.9(D)	18.5(D)	48.1(D)
Links to online resources	5.4(L)	37.8(L)	27.9(L)	28.8(L)
	28.6(D)	14.3(D)	28.6(D)	28.6(D)
Online survey	4.7(L)	34.4(L)	32.8(L)	28.1(L)
	9.1(D)	45.5(D)	18.2(D)	27.3(D)
Other	20.0(L)	30.0(L)	30.0(L)	20.0(L)
	25.0(D)	50.0(D)	12.5(D)	12.5(D)

The Pearson Chi-square statistical procedure was

employed to examine whether each of the possible answers to survey items were equally probable. The results of the Chi-square tests are shown in Table 8. Pearson Chi-square values were shown to be at significant levels for the 2 Web-based learning activities among the student learning styles. As can be seen in Table 8, the *p*-values of the chat room and e-journal were less than .05; the null hypothesis that each possible answer to these two Web-based learning activities among the student learning styles was equally selected was rejected. Additionally, the *p*-values of the other 13 activities >.05; the null hypothesis for these items failed to be rejected.

In other words, a two-way contingency table analysis was conducted to evaluate whether the proportion of participants who most liked Web-based learning activities depended upon whether they were related primarily by their learning styles. The two variables were learning styles with four levels (auditory, visual, kinesthetic/tactile, and multiple learning styles) and each Web-based learning activity with three levels (like, neutral, and dislike). The four learning styles and the chat room and e-journal of Web-based learning activities were found to be significantly related. The other 13 Web-based learning activities and the learning styles were not found to be significantly related.

Table 8 Prevalence for All Response Categories with Web-based Learning Activities Among the Student Learning Styles, *N*=145 (\**p* < .05.)

Variable	$\chi^2$	<i>df</i>	<i>p</i>
Discussion board	1.38	6	ns
Chat room	15.82	6	.015*
Case study	1.45	6	ns
E-mail	4.84	6	ns
E-journal	13.94	6	.030*
Exploring homepage	4.91	6	ns
Group assignment	10.09	6	ns
Individual assignment	6.78	6	ns
Online quizzes	2.71	6	ns
Online examinations	.72	6	ns
Watching video clips	4.21	6	ns
Online presentation	10.06	6	ns
Links to online resources	8.24	6	ns
Online survey	1.94	6	ns
Other	4.28	6	ns

### 9. Analysis of Data Summary

As the data analysis of the demographics information in the study indicated, a total of 145 graduate level students in the Texas A&M University System participated in the study. A review of the participants' age and gender showed the average age of the male participants was greater than the average age of the female participants. The number of female

participants was also greater than the number of male participants.

An analysis of the participants' ethnicities revealed that the largest ethnic group was comprised of Hispanic American students. White American students made up the second largest ethnic group. Native American students were a minor ethnic group in the study. An analysis of the participants' Web-based experience revealed that students who had taken at least one Web-based class comprised the largest group of study participants. The second major was comprised of students who had taken five or more Web-based classes. The minor groups were comprised of participants who had taken only two or three Web-based classes. Two students did not specify how many Web-based courses they had taken, but they must have taken at least one Web-based course. Students were required to have taken one Web-based course before the spring 2005 semester in order to participate in the study. The average number of the Web-based courses taken by survey respondents was 2.85. In other words, each participant had taken an average of 3 courses and possessed a great deal of experience related to Web-based classes.

An analysis of the Likert-type scale items from the questionnaire produced the following results. The participants on average answered "agree" or "neutral" when responding to the statements related to learning styles. Thus, the major responses from participants indicated that they had a positive experience in Web-based classes. Based on the data analysis of Web-based learning activities, the findings revealed that the participants thought that discussion board activity had the strongest influence on students' learning performance, and that the activity of online survey had the least amount of influence on their learning performance.

Based on the data analysis of students' learning styles, it was determined that 55 participants had a visual learning style, 42 participants had a kinesthetic/tactile learning style, 38 participants had multiple learning styles, and 10 participants had an auditory learning style. The largest number of participants preferred a visual learning style, and more participants preferred multiple learning styles than an auditory learning style. The findings indicate that Web-based instructors should provide more visual instruction opportunities for the majority of the students and that they should consider instructional content and activities of the multiple styles to adequately meet the needs of learners.

Based on the data analysis of the relationship between students' learning styles and Web-based

learning activities, students with an auditory learning style selected the category “other” with the greatest frequency as their preferred activities. The category group assignments were selected with the second greatest level of frequency. Students with a visual learning style preferred e-journal activities. Participants with a kinesthetic/tactile learning styles preferred chat room activities. Respondents with multiple learning styles preferred e-journal activities. The results showed that chat room and e-journal activities were significantly related to the learning styles. These findings should be considered by instructors when they design activities for Web-based classes. The activities should match the students’ learning styles in order to meet the students’ needs and increase their levels of satisfaction. Thus, instructors should measure student learning styles when a Web-based class begins. This would create a foundation for instructors to use in developing suitable instructional material and pedagogy for Web-based instructional environments.

#### **D. Conclusion and Recommendations**

Web-based Instruction (WBI) is a prevalent trend in higher education today. Santi (1997) stated that WBI is an emerging realm in education, and learning interest in WBI is evidenced by the quick growth that Web-based courses have experienced. Additionally, schools are able to provide a reliable and inexpensive Web-based resource as an alternative to TTVN, live broadcasts, video tapes, etc. Hence, the main phenomenon is that Web-based learning is becoming a trend in today’s education. Squires and Preece (1996) indicated that usability themes in the design of WBI highlight a lack of attention to the instructional design of Web-based courses. Instructors often neglect to consider the Web-based learning content and activities that are most beneficial to students in Web-based instructional environments.

##### **1. The Relationships of Students’ Learning Styles and Web-based Learning Activities**

The learning styles were divided into the four categories that included auditory, visual, kinesthetic/tactile, and multiple learning styles. The findings based on research question two showed that the many respondents preferred two or more learning styles. These students are designated as having multiple learning styles. If the identical sum score appeared in two or more learning style categories, a designation of multiple learning styles was applied. According to the survey results, those with an auditory learning style most frequently chose the category “other” when selecting a preferred Web-based activity. They selected the activity of group assignment with the second greatest levels of

frequency. The participants with a preference for visual learning style preferred e-journal activities. The participants with a preference for kinesthetic/tactile learning style mostly preferred chat room activities. The participants with multiple learning styles preferred e-journal activities. In short, the results showed that the types of Web-based learning activities had to make a connection with students’ learning style in order to enhance their learning interest and achievement.

The data analysis revealed that the participants favoring an auditory learning style most preferred the category “other” when choosing a preferred Web-based activity. Respondents selected the activity of group assignment with the second greatest levels of preference. Overall, the participants with a preference for auditory learning style tended to desire more Web-based audio-visual activities. The participants favoring a visual learning style preferred e-journal activities that were needed to read information. The participants favoring a kinesthetic/tactile learning style preferred chat room activities because they needed more interaction and physical experience. The participants preferring multiple learning styles favored e-journal activities that provided more wordy research information. Thus, individuals with different learning styles needed different activities, pedagogies, or methods to assist them in learning within Web-based classes. All in all, the results showed that the types of Web-based learning activities had to fit in with the students’ learning style in order to enhance their learning needs, interest, and achievement. Hence, instructors need to vary Web-based learning activity for students’ needs based on the various learning styles. This finding supported the literature review. Tomlinson (1996) stated that teachers must be aware of the learning styles of students and adapt teaching styles and instructional material to meet the needs of these students. Furthermore, it supported the concept that in order to adapt to the variety of learning styles, effective teaching has to involve all senses while addressing the learner needs in a variety of learning activities (Jensen, 1996).

On the other hand, the participants favoring an auditory learning style disliked most the activity of links to online resources because they preferred hearing a message. The participants favoring a visual learning style disliked most activities involving individual assignments. The participants favoring a kinesthetic/tactile learning style most disliked the activity of exploring homepages because they favored a physical motion experience in learning. The participants favoring multiple learning styles most disliked the activity of online presentation. On the



whole, the findings showed there was overlap between participants favoring a visual learning style and participants favoring multiple learning styles. Both groups liked e-journal activities. There was no overlap in Web-based learning activities disliked by respondents.

On the whole, students with an auditory learning style preferred obtaining or hearing the message from their peers or instructors in Web-based classes; consequently, they most favored the activity of group assignment. The students with a visual learning style preferred reading the information in Web-based classes, so they most favored the activity of e-journal. The students with a kinesthetic/tactile learning style liked the activities of physical movement in Web-based classes, so they most preferred the activity of a chat room. The findings matched with Sarasins' learning styles observation from the literature review. An auditory learning style student preferred to have information presented or communicated orally in a group, a visual learner preferred to have information present by graphics, diagram, or a word or visual guideline, and a kinesthetic learner preferred to learn by physical interaction and needed activity interaction (Sarasin, 1999).

Furthermore, the results indicated that the relationships between student learning styles and the activities of chat room and e-journal were found to be significantly related. Thus, the activities of chat room and e-journal were more preferred and popular among certain learning style participants. Contrarily, the findings indicated that the learning styles and the activities of discussion board, case study, e-mail, exploring homepages, group assignments, individual assignments, online quizzes, online examinations, watching video clips, online presentations, links to online resources, and online surveys were not found to be significantly related. These twelve activities were not found to be significantly related to learning styles.

Additionally, students commented that Web-based instructors should train their students to become proficient in using the tools of Web-based classes. This would improve student learning in Web-based courses. Instructors should be aware of students training needs when designing or preparing the instructional content, pedagogy, and learning activities for Web-based classes. The above findings are supported by the literature review. When designing Web-based class, the instructors should select instructional pedagogies and activities that will assist students in achieving the objectives of the Web-based course.

## 2. Recommendations

The findings provide views and insights and suggestions for Web-based instructors when they teach or design a Web-based course. The purpose of the study was to investigate the relationship between student learning styles and Web-based learning activities. This information can provide insight or suggestions for Web-based instructors who create or design Web-based learning activities or pedagogies. Additionally, the findings might encourage Web-based educators to consider such influential factors when developing Web-based instructional content.

In the high technology generation, students' learning styles and needs vary in Web-based instructional environments. The following recommendations were based on the findings from the responses of the participants in the study:

- (1) Instructors should train their students to be proficient when using the tools of Web-based courses. Instructors should provide a training program or orientation for students who would like to take classes in Web-based instructional environments. This would enable students to become familiar with the learning setting.
- (2) Participants prefer to have more interactive learning activities based on their cognition in Web-based classes. Teachers should be aware of this preference when designing activities or instructional pedagogies for Web-based instructional environments.
- (3) Web-based learners prefer to use integration technologies that are combinations of audio lecture with video or PowerPoint to support online presentation. Instructors should offer the online presentation opportunities so that students are able to satisfy their preference for using integration technology.
- (4) The different learning styles of students require different Web-based instructional activities, pedagogies, or methods to assist student learning in Web-based classes. Chat room and e-journal were significantly related to the four learning styles. Educators should attempt to understand students' preferred learning styles prior to designing Web-based courses. The process will be especially beneficial for students preferring multiple learning styles.
- (5) Instructors should try to examine students' preferred learning styles prior to creating Web-based learning activities or instructional pedagogies that attempt to facilitate the

enhancement of student achievement in Web-based classes. This process will allow instructors to more adequately satisfy student needs.

## E. References

1. Bannan, B., & Milheim, W. D. (1997). Existing web-based instruction courses and their design. In B. H. Khan (Ed.), *Web-Based instruction* (pp. 381-387). Englewood Cliffs, NJ: Educational Technology Publications.
2. Bonk, C. J., & Reynolds, T. H. (1997). Learner-centered web instruction for higher-order thinking, teamwork, and apprenticeship. In B. H. Khan (Ed.), *Web-based instruction* (pp. 167-178). Englewood Cliffs, NJ: Educational Technology Publications.
3. Brownfield, K. M. (1993). *The relationship between the Myers-Briggs personality types and learning styles*. (Report No. TM023044). Portales, NM: Eastern New Mexico University. (ERIC Document Reproduction Service No. ED381577).
4. Bunker, E. L. (1998). An historical analysis of distance education forum: The international council for distance education world conference proceedings, 1938 to 1995. (Doctoral dissertation, The Pennsylvania State University, 1998). *Dissertation Abstracts International*, 59, 1864.
5. Cahoone, L. E. (1988). *The dilemma of modernity: Philosophy, culture, and anti-culture*. Albany: State University of New York Press.
6. Caudill, G. (1998). Matching teaching and learning styles. *Technology Connection*, 4(8), 24-25.
7. Collis, B. (1997). Pedagogical- re-engineering: A pedagogical approach to course enrichment and re-design with the WWW. *Educational Technology Review*, 8, 11-15.
8. Custer, R. L. (1996). Qualitative research methodologies. *Journal of Industrial Teacher Education*, 34(2), 3-6.
9. Davidson, G. V. (1990). Matching learning styles with teaching styles: Is it a useful concept in instruction? *Performance & Instruction*, 29(4), 36-38.
10. Dehoney, J., & Reeves, T. (1999). Instructional and social dimensions of class web pages. *Journal of Computing in Higher Education*, 10(2), 19-41.
11. Diaz, D. P., & Cartnal, R. B. (1999). Students' learning styles in two classes: Online distance learning and equivalent on-campus. *College Teaching*, 47(4), 130-135.
12. Dow, M. (2003). *Cognitive consequences of Internet-based teaching and learning and distance education students*. Paper presented at Emporia State University, Emporia, KS.
13. Duchastel, P. (1997). A Web-based model for university instruction. *Journal of Educational Technology System*, 25(3), 221-228.
14. Fortune, A. E., McCarthy, M., & Abramson, J. S. (2001). Student learning processes in field education: Relationship of learning activities to quality of field instruction, satisfaction, and performance among MSW students. *Journal of Social Work Education*, 37(1), 111-124.
15. Gagne, M., & Shepherd, M. (2001). Distance learning in accounting: A comparison between a distance and traditional graduate accounting class. *T.H.E. Journal*, 28(9), 58-65.
16. Gall, M. D., Gall, J. P., & Borg, W. R. (2003). *Educational research: An introduction* (7th ed.). New York: Allyn and Bacon.
17. Goggin, N. L., Finkenberg, M. E., & Morrow, J. R. (1997). Instructional technology in higher education teaching. *Quest*, 49(3), 280-290.
18. Grabinger, R. S. (1996). *Learning about Problem-Based Learning*. Phoenix, AZ: Society for Information Technology and Teacher Education.
19. Green, S. B., & Salkind, N. J. (2004). *Using SPSS for Windows and Macintosh: Analyze and understanding data* (4th ed.). Upper Saddle River, NJ: Prentice Hall.
20. Guild, P. B. (1997). Where do the learning theories overlap? *Education Leadership*, 55(1), 30-31.
21. Hiltz, S. R. (1994). *The virtual classroom: Learning without limits via computer networks*. Norwood, NJ: Ablex Publishing Corporation.
22. Hons, C. (2002). Big ten school in cyberspace. *T.H.E. Journal*, 29(6), 27.

23. Huffaker, D. A., & Calvert, S. L. (2003). The new science of learning: Active learning, metacognition, and transfer of knowledge in E-learning applications. *Journal of Educational Computing Research*, 29(3), 325-334.
24. James, W. B., & Gardner, D. L. (1995). Learning styles: Implications for distance learning. *New Directions for Adult and Continuing Education*, 67, 19-31.
25. Jensen, E. (1996). *Brain-based learning*. Del Mar, CA: Turning Point Publishing.
26. Lynch, T. G., Woelfl, N. N., Steele, D. J., & Hanssen, C. S. (1998). Learning Style Influences Student Examination Performance. *The American Journal of Surgery*, 176(1), 62-66.
27. Jonassen, D., Previs, T., Christy, D., & Stavroulaki, E. (1999). Learning to solve problems on the Web: Aggregate planning in a business management course. *Distance Education: An International Journal*, 20(1), 49-63.
28. Katz, J. (1999). The future is the net. *Media Studies Journal*, 13(2), 14-15.
29. Kearsley, G. (1998). *Educational technology: A critique*. Technology, 38(2), 47-51.
30. Khan, B. H. (1997). Web-based instruction (WBI): What is it and why is it? In B. H. Khan (Ed.), *Web-based instruction* (pp. 5-18). Englewood Cliffs, NJ: Educational Technology Publications.
31. Landis, M. (2000). Faculty strategies for distance teaching. *Educational Technology*, 40(6), 55-57.
32. Liaw, S., & Huang, H. (2000). Enhancing interactivity in Web-based instruction: A review of the literature. *Educational Technology*, 40(3), 41-45.
33. Lynch, T. G., Woelfl, N. N., Steele, D. J., & Hanssen, C. S. (1998). Learning Style Influences Student Examination Performance. *The American Journal of Surgery*, 176(1), 62-66.
34. McCormack, C., & Jones, D. (1998). *Building a Web-Based Education System*. New York: Wiley.
35. Merriam, S. B., & Caffarella, R. S. (1991). *Learning in adulthood: A comprehensive guide*. San Francisco: Jossey-Bass.
36. Moore, M. G. (1993). Three Types of Interaction. In K. Harry, M. John, & D. Keegan (Eds.), *Distance education: New perspective* (pp. 19-24). London: Routledge.
37. Moore, M., & Kearsley, G. (1996). *Distance education: A system view*. Belmont, CA : Wadsworth Publishing Company.
38. McIsaac, M. S., & Gunawardena, C. N. (1996). Distance education. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 403-437). New York: Simon & Shuster Macmillan.
39. Northrup, P. T. (2001). A framework for design interactivity into Web-based instruction. *Educational Technology*, 41(2), 31-39.
40. Norusis, M. J. (2004). *SPSS 12.0 guide to data analysis*. Upper Saddle River, NJ: Prentice Hall.
41. O'Brien, T. P. (1994). Cognitive learning styles and academic achievement in secondary education. *Journal of Research and Development in Education*, 28(1), 10-19.
42. Oliver, R. (1999). Exploring strategies for online teaching and learning. *Distance Education*, 20(2), 240-254.
43. Paulsen, M. F. (1995). An overview of CMC and the online classroom in distance education. In Z. L. Berge & M. P. Collins (Eds.), *Computer-mediated communications and the online classroom* (pp. 31-57). Cresskill, NJ: Hampton Press.
44. Rasmussen, K. L., & Davidson-Shivers, G. V. (1998). Hypermedia and learning styles: Can performance be influenced? *Journal of Educational Multimedia and Hypermedia*, 7(4), 291- 308.
45. Romiszowski, A. J. (1997). Web-based distance learning and teaching: Revolutionary invention or reaction to necessity? In B. H. Khan (Ed.), *Web-based instruction* (pp. 25-37). Englewood Cliffs, NJ: Educational Technology Publications.
46. Rosenberg, M. J. (2001). *E-learning: Strategies for delivering knowledge in the digital age*. Columbus, OH: McGraw-Hill.
47. Ross, J. L., & Schulz, R. A. (1999). Can computer-aided instruction accommodate all learner equally? *British Journal of Educational Technology*, 30(1), 5-24.
48. Ruth, S., & Shi, M. (2001, May/June). Distance learning in developing countries: Is anyone

- measuring cost-benefits? *TechKnowLogia*, 3(3). Retrieved September 15, 2004, from [http://www.techknowlogia.org/TKL\\_active\\_pages2/TableOfContents/main.asp?IssueNumbermbe=11](http://www.techknowlogia.org/TKL_active_pages2/TableOfContents/main.asp?IssueNumbermbe=11)
47. Ryan, R. C. (2000, January). Student assessment comparison of lecture and online construction equipment and methods classes. *T.H.E. Journal*, 27(6), Retrieved October 2, 2004, from <http://www.thejournal.com/magazine/vault/A2596.cfm>
48. Sage, S. M. (2000). A natural fit: Problem-based learning and technology standards. *Learning and Leading with Technology*, 28(1), 6-12.
49. Santi, P. A. (1997). Interactive World Wide Web-Based courseware: Similarities and differences. In B. H. Khan (Eds.), *Web-Based Instruction* (pp. 407). Englewood Cliffs, NJ: Educational Technology Publications.
50. Sarasin, L. C. (1999). *Learning style perspectives: Impact in the classroom*. Madison, WI: Atwood Publishing.
51. Savery, J. R., & Duffy, T. M. (1995). Problem based learning: An instructional model and its constructivist framework. *Educational Technology*, 35(5), 31-38.
52. Schank, R. C. (2002). *Designing world-class e-learning: How IBM, GE, Harvard Business School, and Columbia University are succeeding at e-learning*. USA: McGraw-Hill.
53. Simich-Dudgeon, C. (1998). Developing a college web-based course: Lessons learned. *Distance Education*, 19(2), 337-357.
54. Squires, D., & Preece, J. (1996). Usability and learning: Evaluating the potential of educational software. *Journal of Computers Education*, 27(1), 15-22.
55. Swanson, L. J. (1995). *Learning styles: A review of the literature* (Report No. HE028652). Claremont, CA: The Claremont Graduate School. (ERIC Document Reproduction Service No. ED387067)
56. Swisher, K. (1994). American Indian learning styles survey: An assessment of teachers knowledge. *Journal of Educational Issues of Language Minority Students*, 13, 59-77.
57. Thurber, B. D., Pope, J. W. & Stratton, J. (1995, July). *Computers, telecommunications and western culture*. Paper presented at the World Conference on Computers in Education, Birmingham, UK.
58. Tomlinson, J. (1996). *Inclusive learning: Principles and recommendations – A summary of the findings of the learning difficulties and disabilities committee*, Coventry: Further Education Funding Council.
59. Zolkos, R. (1999). Online education getting good grades: Despite high attrition, online courses seen as a possible alternative to the classroom. *Business Insurance*, 33(42), 40-42