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Course Design Based on the Kolb Learning Style as it Relates to Student Success in Online Classes

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by

Edward John Perantoni
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A dissertation submitted to the Education Faculty of Lindenwood University
in partial fulfillment of the requirements for the
degree of

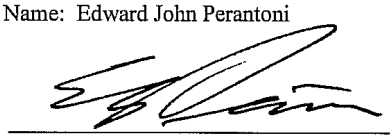
Doctor of Education

School of Education

Declaration of Originality

I do hereby declare and attest to the fact that this is an original study based solely upon my own scholarly work here at Lindenwood University and that I have not submitted it for any other college or university course or degree here or elsewhere.

Full Legal Name: Edward John Perantoni

Signature: 

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Dr. Jann Weitzel, Dissertation Chair	11-23-09 Date
Dr. Paige Mettler-Cherry, Committee Member	11-23-09 Date
Dr. William Emrick, Committee Member	11-23-09 Date
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Dr. Dominic Soda, Committee Member	11-23-2009 Date

Dedication

This dissertation is dedicated to my wife,

Lu Perantoni

Acknowledgements

I wish to thank my committee for all the hard work they put into reading this dissertation and for all the constructive criticism and recommendations they offered. They kept me focused and on track. Dr. Jann Weitzel, Committee Chair, provided a tremendous amount of guidance on the topic of online learning as well as grammar inconsistencies. Dr. Paige Mettler-Cherry, Science Member, provided her insight into what a scientific research project should accomplish as well as fine tuning the writing of a scientific research paper. Dr. William Emrick, Education Member, helped keep me focused on a narrow topic that helped me produce a concise, non rambling study. Dr. Dominic Soda, Science Member, provided guidance on correct math interpretations. Finally Dr. Bruce Kelly, Science Member, added his professional knowledge on cognitive studies.

I wish to thank the students who participated in the study. They were the ones who had to endure my thoughts on group work and accomplish the tasks for course completion in either the online mode or the bricks and mortar mode. Some folks preferred group work, while others did not like it. I appreciate the students bearing with me and following through on their assignments.

I wish to thank my wife, Lu Perantoni, for her support in this endeavor. She was my foundation and rock throughout the process, encouraging and prodding me to always push forward. She had such strong faith in me and my abilities. I owe her a tremendous debt of gratitude and love.

Abstract

Educators are taught that differentiated instruction is important to ensuring that students are offered an opportunity to learn. As a result, student learning styles become important in the design of an online course. Certain students prefer group work, discussions, and brainstorming sessions all of which are part of the socialization process. Kolb related the ability of a student to learn through the socialization process to the accommodator and diverger learning styles. The researcher hypothesized that the development of a quality online course, as defined by NACOL, should include socialization techniques such as group work. Therefore, the purpose of this study was to determine if there was a relationship between the accommodator or diverger learning styles and mean improvement scores in a class. The improvement scores of the experimental group should be higher than those of the control group in a quality online course. Two fall 2008 Meteorology classes, one online class and one traditional class, were established as the in which no group work was conducted. Two spring 2009 Meteorology classes, one online class and one traditional class, were established as the experimental groups in which group work was conducted. From the mean improvement scores, it was concluded that group work aided the online accommodator. However, closer analysis of the group work revealed the experimental group improvement scores were lower than the control group improvement scores for the two objectives under investigation. Mean improvement scores for the traditional class indicated that group work did help the learner. This was verified through a closer analysis of the group work where it was found that the experimental group improvement scores were higher than the

control group scores for each of the objectives. Gender, ethnicity, and year in school were also tested, but no statistically significant relationship was identified relative to the mean improvement scores. Future studies related to group work should concentrate on either online classes or bricks and mortar classes, ensure that the population studied is sufficiently large enough to make a causative conclusion, and collect data from different classes.

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Chapter One—Introduction

Teaching online courses provides an insight into the motivation, planning, and prioritization processes of many students. It allows the instructor to assess socialization and communication skills as well as test the knowledge base of the student. Consequently an online course should be carefully designed to fully maximize the student's abilities to demonstrate those skills. As a means to accomplish this, it would be helpful to determine if there is a relationship between student learning and performance in an online course and the quality of a course. The fact that not all students acquire knowledge in the same fashion should be remembered as a teacher develops a quality online course. Student learning style should be an important consideration in the design of the course. Many factors may impact student success (Figure 1).

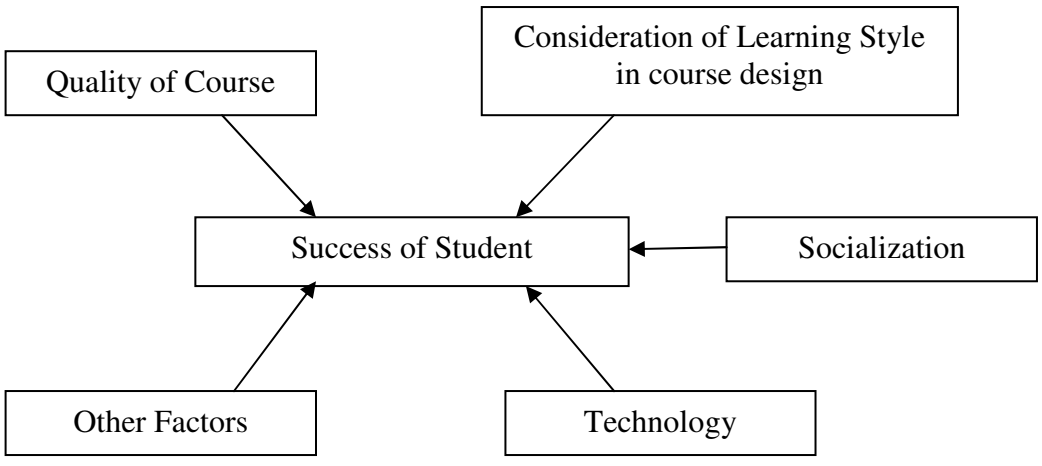


Figure 1. Factors impacting student success.

Learning styles have been defined in many ways, causing confusion in the research field. The Kolb learning style theory was selected for this study (Businessballs, 2005). One element of the Kolb learning styles concept addresses a category of students who prefer to learn through group work, and this element will be the focus of this study. The reason for selecting this element is researchers have shown there is a relationship between social interaction and learning style. One element of social interaction used in this study will be group work. Data will be collected and analyzed relative to that element (Figure 2).

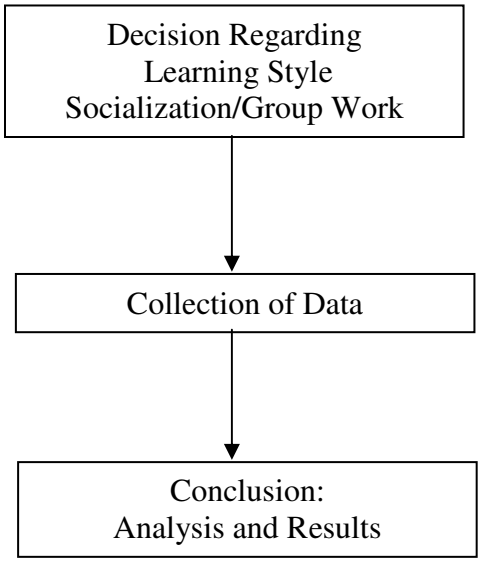


Figure 2. Process of this study.

Background of the Problem

Distributed learning via mass media has evolved over the years. Courses were first offered over radio in the early 1920s followed by television in the 1950s (Lane & Portway, 1994, p. 199). Currently it is common to view telecourses over public television

or some cable networks. The advantage of taking such a course is that the student merely watches TV for a specified period of time and completes course work as assigned without required attendance in a classroom. As technology advanced in the 1990s, the ability to transmit large packets of information over the telephone wire became popular. The original dial-up modem evolved into Digital Subscriber Lines (DSL) and Satellite. Currently it is not uncommon to view a college class online in streaming video. As technology grew and society became more technologically savvy, the popularity of online courses grew as well. Wirt et al. (2004) reported online enrollment increased from 1997 through 2001as follows:

> In 2000-01, 56 percent of all postsecondary institutions offered distance education courses, up from 34 percent 3 years earlier. The number of course enrollments in distance education nearly doubled between 1997–98 and 2000–01; by 2000–01, about half of these enrollments were at public 2-year institutions. (Wirt, et al., p. ix)

The number of enrollments in online courses at 4-year public schools increased from 711,000 in 1997-1998 to 945,000 in 2000-2001. The number of enrollments in online courses at 4-year private schools increased from 222,000 in 1997-1998 to 589,000 in 2000-2001 (p. ix). In addition to individual courses, degrees and certificates began to be offered at all levels of higher online education (p. 32).

With the tremendous growth in such courses and programs, the business as well as the education communities became concerned about the effectiveness of such courses. When a student is not in a classroom where a teacher can physically observe the student discussing the course materials, the teacher may have a difficult time determining if the

student is actually learning the materials. The teacher may have a difficult time determining if the assessments effectively evaluate learning. And the ultimate concern relates to the learning in the traditional bricks and mortar classes being on par with the learning in the online classes. These concerns all relate to the student's involvement with the course material/teacher/other students in the classroom.

Perhaps more intriguing are thoughts/doubts that relate to the development of online courses. Teachers would like to know if the material being presented online is done so in a manner that enhances learning. It is possible that in order to understand that thought the teachers need to take time to understand their online students and their individual capabilities. Differentiated instruction may need to be incorporated into the design of the curriculum of online courses to make sure that students participating in the courses are able to understand the material.

Such doubts may illustrate the need for standards of excellence in the development of online course materials. The North American Council for Online Learning (NACOL) published a brochure titled *National Standards of Quality for Online Courses*. The focus of the brochure was to provide guidance to states and districts for teachers developing K-12 online courses. The members of NACOL based their work on a review of literature pertaining to online courses and eventually approved the standards for a quality online course developed by the Southern Regional Education Board (North American Council for Online Learning, 2006, p. 2). The standards were presented in the form of a checklist which covered six broad categories: (a) Content, (b) Instructional Design, (c) Student Assessment, (d) Technology, (e) Course Evaluation and Management, and (f) 21st Century Skills (NACOL, 2006, pp. 3-7). The category

Instructional Design contained 16 items in its checklist. Three of the checklist items addressed student learning style preferences either directly or indirectly:

1. The course instruction includes activities that engage students in active learning.
2. Instruction provides students with multiple learning paths to master the content, based on student needs.
3. The teacher engages students in learning activities that address a variety of learning styles and preferences. (p. 4)

The second brochure published by the NACOL (2006), titled *National Standards for Quality Online Teaching,* is also in checklist format. A major section of the checklist titled "The teacher plans, designs, and incorporates strategies to encourage active learning, interaction, participation, and collaboration in the online environment" (NACOL, 2006, p. 4) and contains 15 items to be reviewed by the course developer. Three of the checklist items address learning style either directly or indirectly: "(a) demonstrates effective strategies and techniques that actively engage students in the learning process, (b) promotes learning through group interaction, and (c) differentiates instruction based on students' learning styles and needs and assists students in assimilating information to gain understanding and knowledge" (p. 4). To summarize, if a teacher develops an effective online course, the course should actively involve the students, include group interaction, and differentiate instruction based on student learning styles.

Since the lecture mode is not usually part of an online course (Dutton, Dutton, and Perry, 2001, ¶4), the teacher should look to other means that enhance learning in the presentation of the the materials to the student. Promoting the concept of group learning implies some form of social communication, be it discussion groups, brainstorming sessions, or just a few people considering an idea over a cup of coffee. As students consider various concepts, the teacher hopes that learning will take place; some students are going to change their knowledge base about the concept being discussed. Others may reject the concept outright.

The implication of the three items from the checklist is that online learning can be enhanced with group interaction through differentiated instruction based on learning styles. Teachers use their knowledge of learning styles as a means to engage the student actively in the learning process. According to the checklist, such instruction involves social interaction between the students. To facilitate that social interaction group work will be employed. Hence, a quality online course needs a social component that accomodates such interactions among students and is varied enough to accommodate differing learning styles.

Assumption

The terms social interaction, group interaction, group work, brainstorming, etc. are used throughout this research project. It is recognized that social/group interaction is not the same as group work. However, a component of social/group interaction may be group work. This research project will concentrate on using group work to facilitate social/group interaction.

Statement of the Problem

With the increase in the number of online courses, there is also an increase in the number of students who do poorly in the courses and/or drop out, resulting in a waste of the student's time and finances (Angelino, Williams, & Natvig, 2007, pp. 3-4). Studies have been conducted that address the gender, age, and ethnicity of these unsuccessful students (Patterson & McFadden, 2009, ¶2). Studies of the demographic characteristics of students as related to course success, may not address the true reason a student may not learn the course material and quite possibly drop the course. The challenge is to identify and match course design to student learning styles to accommodate as many students as possible, before the online course is administered.

Research in online dropouts lists a variety of factors causing attrition. Most of the reasons involve social factors such as family problems, finances, etc. (Parker, 1999, ¶ 1; Willging & Johnson, 2004, p. 105; Yukselturk & Inan, 2006, p. 8). The burden of failure to complete an online course successfully has been placed historically on the student. Motivational studies have been completed that identify low student locus of control as a contributing factor to online course attrition (Parker, 1999, ¶ 1). Chyung (2001) identified attention, relevance, confidence, and satisfaction of the students enrolled in Boise State University online programs as factors contributing to online attrition (¶ 16).

The problem of poor performance or attrition in the online course could be a consequence of any number of issues. Perhaps the course was poorly designed by the teacher. Maybe the student started an online course with high enthusiasm and motivation but found that he or she did not understand the requirements of the course and simply decides to drop the course. The dropout problem could stem from the inability of the

designer to apply those social interaction aids that are related to student learning styles. Or maybe the lack of incorporating social interaction (learning style) in the form of group work might impact the student's success. Assuming the course incorporates the tenets of the NACOL checklist, the knowledge of the student's learning style might help with the decision of an advisor to tell the student whether he or she should take an online course.

Understandably, a course cannot practically be developed that accommodates the learning style of every student, and there is not enough time once the course has started to significantly modify the content. Additionally, it is rare to have a college professor test each class he or she teaches to ascertain the learning style of each of the students. Many professors may have 100, 200, or more students, depending on the number of courses taught and institution type. Such a volume of students makes it impossible to tailor the course to each student. However, this should not deter the designer from developing a quality online course that incorporates student learning style characteristics in the attempt to increase the students' odds of success.

Rationale for the Study

If an institution is to have a successful online program, it needs to ensure that course developers consider the "best practices" for each online course created. One of the elements of "best practices" for online course creation may be the social interaction relative to the learning style of the students in the course. The problem then becomes one of examining social interactions of students in general and identifying the reason or reasons why some students perform poorly in online courses.

The goal of this study is to examine the relationship between student learning style, student performance, and the design of an online course. This investigation may provide a means to identify students who potentially will do poorly in an online course based on the omission in the online course of student's preferred learning style characteristics as a result of a poorly designed course. Having such an indicator would allow the course developer to design an online course that minimizes the risk of students earning a low performance score in the class simply because of course design.

Purpose of the Study

Online courses are different from the traditional bricks and mortar courses in several ways. It takes more time to develop an online course than it does a standard course because of the formatting required for the content matter; the materials may need to be organized using special software that encodes in html language, for example. It also requires a means for the faculty member to communicate with the students using e-mail, discussion, or chat rooms, as part of the feedback process. Content matter may be the same, but presentation of the content matter has to be significantly different, particularly if it is an asynchronous course (*i.e.,* students do not all enter a discussion or chat room at the same time). First, there is no standard lecture mode where the faculty member stands in front of the class and discusses course content. Second, the faculty member is not able to *read* the student's facial expressions to see if the content of the course was understood. Third, the student does not have a chance to ask questions during a lecture because the class does not meet face to face. Fourth, there is no face to face social interaction between students and the faculty member. The ways that online courses differ from bricks and

mortar courses call attention to the importance of the course design process. The differences can be compensated for through deliberate action by the course designer in the development of the online course. It is incumbent on schools to have an established policy that identifies the requirements for a high quality online course. The stated goal of such a policy should be to encourage the development of online courses that enable and enhance student learning. Checks and balances should be required through assessment programs that verify the students are learning the material.

The purpose of this study was to test whether success in an online course is related to the social interactions of students with each other in the course. Social interaction is characteristic of certain learning styles. Therefore, identifying the learning style of each student in an online class should provide the information necessary for the course designer to construct a quality online course that addresses the needs of the student.

Variables

Data. Descriptive data collected include student identification, gender, age, year in college, ethnicity, pretest score, posttest score, and learning style. Pretest and posttest scores will be analyzed and compared to the learning style of the student to identify any patterns.

The experimental groups used in this study will be assigned group work and the performance score for each student will be identified. The change in performance scores for those students assigned group work will be compared to the change in performance scores for those students not assigned group work. Any change in performance scores

will be analyzed for significant differences. An exit interview will be conducted with students who withdraw from the course to identify their reasons for not completing the course. If it appears that the social interaction of the students is not the issue, then other parameters will be examined such as the performance score as compared to gender, ethnicity, or class in college.

Independent variable. The independent variable in this study will be group work. The control group will not be assigned group work and the experimental group will be assigned group work.

Dependent variable. The dependent variable will be the posttest score minus the pretest score or the mean improvement score.

Hypotheses

The null hypothesis and alternative hypothesis will be considered in the online classes as well as in the bricks and mortar classes.

H_0: Students who are categorized as social learners will either increase or not increase their improvement score. H_0: $\mu_{experimental} \geq \mu_{control}$

H_1: Students who are categorized as social learners will have significantly lower improvement score. H_1: $\mu_{experimental} < \mu_{control}$

Research Questions

Several questions need to be addressed in this study: (a) Were accommodator or diverger student (learns well with group interaction) performance scores significantly lower or higher than the rest of the class? (b) Were the assimilator or converger student

(does not learn well with group interaction) performance scores significantly lower or higher than the rest of the class? (c) Did the group work offered in each experimental group class have a significant impact on the performance scores? (d) Were the reasons that students did not successfully complete the course due to technical limitations, personal issues, process issues, or course design issues? (e) Were performance scores attributed to other factors such as age, gender, or ethnicity? (f) Were there any biases in the data or data collection process that might have a serious impact on the overall results of the study?

Limitations of the Study

Researchers in education have tried to define different types of students (*i.e.,* pre-K, primary, secondary, post secondary, or adult). There is no consistency in the definition of these categories. Attempts have been made to ascribe learning styles to each category; however, some of the categories overlap. One issue that is not addressed, and may be a limitation in this study, is the difference between a post secondary learner and an adult learner. Typically the post secondary learner is someone who graduated from high school and went immediately into a four year college. An adult learner, according to Horn (1996) and Choy (2002), is typically someone who delayed attending post secondary school, is self-sufficient, is a single parent, or does not have a high school diploma but a GED (p. 3). The difficulty with the existence of a difference between these two definitions is that it is possible to have a student who is 18, who earned his or her GED, and who enrolled immediately in a four year college. That student, the adult learner, is the same age and mental capacity as the postsecondary student who completed high

school and attended college the next fall. Because of the conflict in definitions, the analyses of data in reference to post secondary or to adult learner has been avoided in this study.

Another limitation is the difficulty encountered in arriving at a conclusion about learning style. Some theorists separate it from cognitive style while others conclude that cognitive style is part of learning style. Some researchers, using the Meyers Briggs Type Indicator, consider personality typing as a learning style. In this study, learning style is considered to be a process of getting information to the brain, while cognitive style is considered to be the way the brain processes the information (Merriam, Cafarella, & Baumgartner, 2007, p. 406).

A third limitation is that the experiment was conducted at only one university. Although the data collected came from four different classes, the bias of one school's policies and methods of teaching were ever present. Also, any biases hidden or prevalent were present as only one professor participated in the experiment. To ensure low or no bias and to have a representative sample, data needs to be collected from two or more universities.

Definitions of Terms and Symbols

Accommodator. A person whose learning abilities are based on "concrete experience and active experimentation" (Kolb, 1984, p. 78) in his/her learning process.

ANOVA. The acronym for analysis of variance, a test designed to compare two or more parameters and identify if there is or is not a significant relationship between them (Bluman, 2003, p. 542).

Assimilator. A person whose learning abilities are based on "abstract conceptualization and reflective observation" (Kolb, 1984, p.78).

Asynchronous. Communication that occurs when only one person can communicate at a time, sometimes called delayed communication (Johnassen, 2000, p. 245). Asynchronous courses allow the student to access the course materials on his or her own time schedule; the teacher and student generally are not communicating at the same time as they would in a synchronous online course.

Cognitive style. The activity related to the ability of the brain to process information; it is how the student processes the information he or she has access to (Merriam, Cafarella, & Baumgartner, 2007, p. 406).

Converger. A person whose learning abilities are based on "abstract conceptualization and active experimentation" (Kolb, 1984, p. 77).

Differentiated instruction. A teaching method that is (a) proactive, (b) more qualitative than quantitative, (c) rooted in assessment, (d) provides multiple approaches to content, (e) student centered, (f) a blend of whole-class, group, and individual instruction, and (g) organic (Tomlinson, 2001, pp. 3-5). As an example, a teacher might assign the fast learners to discover, on their own, the reason clouds form. The slower students might be guided through an experiment to develop a cloud in a chamber.

Diverger. A person whose learning abilities are based on "concrete experience and reflective observation" (Kolb, 1984, p. 77) in their learning process.

Equivalency test. An hypothesis test performed to verify if there is or is not a relationship between two variances.

Improvement score. The delta or numerical difference between the posttest score and the pretest score.

Learning style. For the purposes of this paper, the process of receiving information into the brain in preparation for processing.

Normality test. A test conducted to verify that the data set meets the criteria for a standard normal distribution.

Objective 1. A meteorological concept students need in order to understand the thermal structure of the atmosphere

Objective 7/8. A meteorological concept students need in order to understand the relationship of airmasses to fronts.

Online course. A course in which materials are presented to the student on an Internet based platform such as WebCT and not in the traditional "bricks and mortar" environment.

Summary

The purpose of this study was to test whether student success in an online course is related to the social interactions of students with others in the course. Social interactions are beneficial to students with certain learning styles. Control groups not assigned group work were compared to experimental groups assigned group work to identify significant differences in mean improvement scores.

Chapter Two—Literature Review

While completed studies indicated that the effectiveness of online courses matched that of the traditional "bricks and mortar" courses (Hiltz, Zhang, & Turoff, 2002, p. 15; Campbell, 2002, p. 61), questions relative to the quality of the online courses continue to rise from all quadrants. Business questions online learning because of its lack of social interface with other people, lack of rigor, and lower skill sets (Columbaro & Monaghan, 2009, ¶ 17). Faculty not familiar with the development and presentation of an online course may look at the method as an easy way to deliver course material with minimum amount of work. Many do not realize that a tremendous amount of work must go into the preparation and conducting of a quality online course. Some students see the courses simply as a way of not having to go to a lecture. They may view the online media as an easy way to complete a course and even obtain a degree. Other students claim they learn best if the teacher is present for the traditional lecture.

Some issues arise relative to the effectiveness and quality of online courses: (a) there appears to be a high dropout rate for online courses when students believe online courses are easy, (b) there must be a basic cause for the drop out rate for online courses, (c) the quality of the course may be a determinant in the online course drop out rate, (d) the expectations or requirements of the student may not have been met causing the student to disenroll, (e) there may be a lack of motivation of the student as a causative factor for disenrollment, (f) there may be special traits/characteristics common among students who are able to start and successfully complete an online course, (g) the learning

style of the student may play a role in the student's ability to successfully complete an online course.

This research will attempt to find if there is any relationship among performance in an online course, a specific learning style of the student, and the quality of the online course. It is hoped that the results of this study will lead to the identification of a cause for lack of success, (*i.e.*, cause for poor performance or high dropout, in online courses).

The literature review is divided into four sections. The first section covers the current research relative to reasons students drop out of online courses. The second section is a review of the literature pertaining to those items necessary to create a quality online course. The next section is a review of the literature regarding learning styles. Since there is a great deal of literature pertaining to that subject, it was necessary to be selective when reviewing the learning styles and identifying the pros and cons of each. Finally a detailed explanation of the Kolb learning style as well as the reasons for selecting it as the learning style inventory of choice in this research will be addressed.

Online Dropouts

As the number of online courses grows, so does the dropout rate for those courses. According to Terrell (2005), the dropout rate is reaching epidemic proportions (¶ 24). Other literature reveals that the dropout rate can be as high as 30% to 50%. In Europe, the dropout rate for online courses was 20% to 30% in 1992, and in Asia it was recorded as high as 50% in 1999 (Yuksselturk & Inan, 2006, p. 1). In a review of more recent literature, Tyler-Smith found dropout rates ranging from a high of 70-80% in 2000, 2002, and 2004 to 20 to 50% in 2000 (Tyler-Smith, 2006, p. 73). There is no consistency in the

numbers reported in various other studies. What is evident is that a large number of students drop out of online courses. Such high attrition rates raise questions as to the cause. Studies have been done to isolate reasons for such a high dropout rate. Several examples follow.

Parker (1999) of Gonzaga University conducted a study to predict the dropout rate for distributed learning courses and found that the two prime causes are locus of control and self-pay. Locus of control is a state of mind where the student believes that the outcome of an event is based on his or her own behavior. Students with an internal locus of control could focus better on the task at hand, whereas those without could not center on the task and complete it. The second factor, the student financing the course as opposed to his or her family, increased the likelihood of dropout when family matters and the job became more important than the course (Parker, 1999, ¶ 36). Thus, according to Parker, the causes for dropping out of an online course are a mix of internal factors and external factors.

Terrell (2005), using the premise that the attrition rate in educational institutions is high, studied the importance of considering the learning style of a student as a standard in online curriculum design. The data parameters he collected were age, gender, ethnicity, and learning style of doctoral students (¶ 7). He used the Kolb Learning Style Inventory to type the students' learning style (¶ 7). His conclusion was that the graduation rate as compared to the learning style was not statistically significant for this level of student, or looking at it from the attrition standpoint, dropouts were low to none (¶ 17). He recommended further study be done with undergraduate students (¶ 25).

With the introduction of the Internet, the cell phone, and instant messaging, our society has become one that relies less on face to face conversation and more on digital connectedness. Overall this less personal mode of communication has resulted in a higher level of technical interaction. Willging and Johnson (2004) conjectured the reason students dropped out of online courses was due to "issues of isolation, disconnectedness, and technological problems" (Willging & Johnson, 2004, p. 105). Their data was collected through a survey and they found that students enrolled in online courses because of the flexible nature of the schedule, but they dropped out of the program for an assortment of reasons. These reasons can be categorized into three main areas: (a) personal, (b) job related, and (c) program-related. Personal reasons are tied to either finances, assignment deadlines, schedule conflicts, or family problems. Job related reasons involve a change in job responsibilities, the lack of company support for the program, or difficulty completing the course while working. Program related reasons deal with too many insignificant assignments, group work, lack of interaction with instructors and/or students, difficulty of the course, and lack of interest in the material (pp. 114-115). These studies indicate that some of the students do not place the same value on an online course that they do a "bricks and mortar" class. There does not seem to be a high level of acceptance of responsibility for online education.

Yukselturk and Inan (2006) started their research into online attrition by examining existing studies and found no consistent pattern. They identified a multitude of reasons for high attrition ranging from "not enough time to study" to "lack of social integration." Working through three Information Technologies Certificate Programs offered by the Middle East Technical University, they sought to identify specific causes

for people dropping out of the certification program. They created a survey and e-mailed it to three classes in which there were dropouts. Their survey was both quantitative and qualitative. The qualitative portion of the survey, open-ended questions, was used to verify the quantitative portion. They identified 98 dropouts and had a return of 26 surveys or about 25%. Using a 5-point Likert scale they found that the reasons for dropping an online course are either personal or program problems. Personal problems include not enough time to study or job, family, or financial issues. Program problems range from poor support to little, or no, individual feedback. Dropping the course because of exam failure was not high on the list (Yuksselturk & Inan, 2006, pp. 1-8).

Martinez (2003) addressed the problems that institutions have with e-learning dropouts. She maintained that each institution must have an attrition plan that overcomes the dropout problem. Her premise was that the attrition studies concentrate on a wide variety of causes such as finances, age, gender, etc., when the best predictors can be found in an individual's independence, goal orientation, and locus of control. Based on her review of the literature, she considered locus of control to be the level of control an individual has over managing his or her life. She concluded, as did Parker (1999), that students with a strong internal locus of control will be highly motivated and, consequently, successful in the online course. This led her to believe that the traditional reasons, such as family matters, outside job, finances, etc., for dropping out of online courses were minor compared to the psychological factors of locus of control and goals (Martinez, 2003, pp. 9; Uba, 1997, p. 1).

Tyler-Smith (2006) conducted a literature review of articles addressing those factors that cause a student to drop out of an online course. He pointed out that Tinto

(1975, 1987) had devised the Longitudinal Model of Individual Departure, a model that has been used widely by many colleges to predict attrition rates as it dealt with the social and academic integration of the student. The results obtained from using the model suggested that if a student is socially integrated with his or her peers on campus, his or her retention rate in online courses will be quite high. Tyler-Smith also pointed out that Kember (as cited in Tyler-Smith, 2006, p. 74), in studying the Tinto model (as cited in Tyler-smith, 2006, p. 74), had devised a complex conceptual model that included variables of "family context and background, personal motivation, abilities and depth of commitment, previous educational experiences and achievement, and institutional support" (p. 74). Tyler-Smith relates that Kember's Model (as cited in Tyler-Smith, 2006, p. 74) purports that the students in online courses are more mature adults with families rather than the typical postsecondary student, and the social integration aspects of the typical college campus student do not apply to the so called "nontraditional" student because their roles in life are completely different (p. 74).

Tyler-Smith (2006) found that each study showed many different barriers to learning online. In a web-based survey, students reported the following items to be barriers to online learning: "1. Technical problems, 2. Cost of and access to the Internet, 3. Time and support for studies, 4. Personal motivation, 5. Technical skills, 6. Academic skills, 7. Social interactions, 8. Administrative/instructor issues" (Tyler-Smith, 2006, p. 76). These barriers become an important issue when calculating a return on the investment both in dollars to the institution and satisfaction of the learning process to the student.

After reviewing many issues, Tyler-Smith (2006) proposed a multi-dimensional model to address the many tasks a first time student in an online course must face (p. 79). The conclusion of the study was that the first-time online student has too many tasks to accomplish. This led to Tyler-Smith's conclusion that the most significant cause of online attrition is attributable to cognitive load theory. The first-time online student will be overwhelmed the first two weeks of the course. Not only does that student have to learn the course material, but he or she has to contend with the technical issues of operating the software/platform to access the course content (p. 81).

Wojciechowski and Palmer (2005) addressed the attrition problem when they examined thirteen parameters as possible reasons for success in an online course. The purpose of their research was to make available to the advisors information on those students who had a high probability of successfully completing an online course. Of thirteen independent variables, six of them showed a positive Pearson correlation to the dependent variable of grade in the course. Those six factors included each of the following: (a) GPA, (b) attendance at an orientation class, (c) the number of withdrawals from other online classes, (d) the Assessment of Skills for Successful Entry and Transfer (ASSET) reading scores, (e) a grade in a previous online course, and (f) the age of the student (Wojciechowski & Palmer, ¶ 19). GPA has the highest correlation ($r = 0.697$). Students with a high GPA did better in online courses (Wojciechowski & Palmer, ¶ 21). The second highest factor was attendance at an orientation session for the class ($r = 0.338$). This provided a sense of connection and commitment to the online course (Wojciechowski & Palmer, ¶ 22). Age was at the bottom of the list ($r = 0.157$) where younger students in educational experience had lower scores in online courses than the

upper class students. These top six items provided a benchmark for institutions when evaluating costs for both the student and the school in the development of online programs (Wojciechowski & Palmer, ¶ 27).

Taken together, the previously discussed studies suggest that if a high GPA correlates strongly to successful completion of online courses, it may be related to motivation. Other factors may also relate to other psychological characteristics of the student. Parker (1999) and Martinez (2003) have studied Locus of Control, a psychological characteristic, and suggested it to be a significant factor in success in online courses.

Levy conducted a study in 2004 on the dropout from online courses. He compared students who completed the online course to students who dropped. He considered several parameters, including locus of control. From the outcome of Levy's study, it was determined that locus of control is not a factor in the decision to drop out of an online course. A second parameter studied was student satisfaction where students taking an online course using WebCT were surveyed regarding their satisfaction with the platform. Levy wanted to know if there is a connection between dropouts and level of contentment with the course. The results suggested that satisfaction is a major contributor to the dropout decision; those highly satisfied had a lower dropout rate than those dissatisfied. Other demographics considered were "gender, age group, residency status, academic major, GPA, and weekly working hours" (Levy, 2004, p. 198). No differences were noted in these variables between "completers" and dropouts taking online courses (Levy, 2004, p. 198). Of note is that this study was reduced to a qualitative analysis of answers in the

survey such as “did you like the course or not.” The analysis did not consider course content.

Thirty community colleges were surveyed in an attempt to identify the reasons students dropped out of online courses. The researchers studied the attrition issue from a business standpoint. Their concern was that dollars are lost to a school when a student does not complete a course because fees are returned to the student or, in the case of some scholarships, the fees are returned to the government. A common single explanation for attrition was sought, but none was found. Instead many reasons were identified, which were grouped into three categories: psychological, technological, and social. Psychological factors included self efficacy, motivation, resourcefulness, persistence, time management, and learning style. Technological factors included technology efficacy, email management, Internet search, file management, word processing, and available technical help. Social factors included associations such as peer/instructor interaction and partnership/teamwork, learning community, help seeking, and online participation. The end result of this study was to recommend early identification of potential dropout students and provide effective intervention (Liu, Gomez, Khan, & Yen, 2007, pp. 538-539).

Quality Online Courses

Course designers should be aware of the elements that make a quality course. The literature was reviewed to see if certain elements exist in a quality course and why they are necessary in the design of an online course. This section of the literature review

addresses the question of whether there is a standard definition for quality in an online class.

Known for its research in online education, the Sloan Consortium published a report in 2002 that established a standard for evaluating the quality of an online program at an institution of higher learning (Lorenzo & Moore, 2002, p. 4). The thinking behind this report went beyond consideration of "learning effectiveness." Lorenzo and Moore (2002) suggested that there is more to the development of an online program than just ensuring that learning takes place as demonstrated through exams, reports, etc. In their report, five "pillars" of a quality online education were identified (Lorenzo & Moore, 2002, p. 4).

Pillar I, titled *Learning Effectiveness*, addresses two main topics. The first is whether the course is designed to include active learning exercises that require the student to think. The second is whether the course is designed to require the students to think on a higher level and relate their thoughts to other students (Lorenzo & Moore, 2002, p. 4).

Pillar II, titled *Student Satisfaction*, addresses the issue of whether the students are happy with the education they received in the online class. They were asked whether they would take another online class or whether they would recommend such a class to their friends (Lorenzo & Moore, 2002, p. 4).

Pillar III, titled *Faculty Satisfaction*, addresses several issues. The first issue relates to positive interaction between the faculty member and the student in the online environment. The second issue addresses the relationship of teaching effectiveness and the use of the online environment. The third issue addresses the support the faculty

member receives from other faculty not teaching in the online environment, and the fourth issue considers whether the learning process is enhanced by the use of technology (Lorenzo & Moore, 2002, p. 5).

Pillar IV, titled *Cost Effectiveness*, addresses the control of costs to ensure that the institution remains competitive. This part of the report concerns the business side of an online program and whether a school can provide both a low cost program and effective learning. Additionally, the competitiveness of the school becomes a large issue with rising operational costs of the school in a time when available funding diminishes (Lorenzo & Moore, 2002, p. 6).

Pillar V, titled *Access*, addresses the line of "help" services available to the students for those times when the software or system does not allow the student to complete his or her course work. The intent here is to make sure that there are services available to help those students who are technologically challenged (Lorenzo & Moore, 2002, p. 7).

The Higher Learning Commission published a checklist for institutions to use in evaluating online courses. It is divided into five categories: (a) Institutional Context and Commitment consisting of ten subcategories with multiple questions in each, (b) Curriculum and Instruction consisting of five subcategories with multiple questions, (c) Faculty Support consisting of four subcategories and questions, (d) Student Support consisting of six subcagegories and questions, and (e) Evaluation and Assessment consisting of six subcategories and questions (Higher Learning Commission, 2007). Although their online best practices were published to help educational institutions

develop a sound online degree program, their guidelines provide help in understanding the need for quality in online courses.

The U.S. Department of Education, Office of Postsecondary Education, published a report in 2006 that addressed quality in online courses. The data collection was based on comments obtained from discussion sessions involving 19 participants from 12 accredited schools. The report covered several topics and was formated to address the pros and cons of online courses. Six categories were considered: Mission, Curriculum and Instruction, Faculty Support, Student and Academic Services, Planning for Sustainability and Growth, and Evaluation and Assessment (U. S. Department of Education, 2006). The majority of the document addresses the administrative side of the planning and implementation of online courses. However, one evaluation criterion directs the evaluator to review the syllabus of the online class for evidence of student participation in group projects and discussions, and in particular, interaction between student and faculty and between student and student. Satisfaction of this criterium is necessary for accreditation of the online program (U. S. Department of Education, 2006, pp. 3-11).

The North American Council for Online Learning (NACOL) published two brochures relative to online courses. The first brochure, *National Standards of Quality for Online Courses*, is a checklist that sets the standards for the development of quality online courses. It contains six major categories: Content, Instructional Design, Student Assessment, Technology, Course Evaluation and Management, and 21st Century Skills (NACOL, 2006). This checklist is geared more to individual online courses and not online degree programs. The evaluation questions are detailed and allow for the evaluator

to assign a score ranging from a low of 0 to a high of 4. The questions within the Instructional Design section relate specifically to the student and his or her ability to master the content based on learning styles (NACOL, 2006, p. 4). The second brochure, *National Standards for Quality Online Teaching*, from NACOL identifies 13 major categories that should be evaluated when teaching an online course. The checklist items within each category deal with the teacher's approach to the online class from both a developmental and operational use standpoint. The third major category of the checklist focuses on the student and the identification of his or her learning style. It also promotes learning through group interaction (NACOL, 2006, p. 4). The checklist offered in the second brochure appears to be more about the student and less about management and operation of the course.

Abel (2005) wrote a short article for *Educause Quarterly* in which he addressed best practices to be used in online learning. His article is based on a major study and paper that he wrote on the subject in 2005. He identified 11 factors necessary for success in online learning. Those factors for success are not student related, but institution related, such as Executive Leadership and Support or Faculty and Academic Leadership Commitment. None of the major factors for success relate to the development of the curriculum in light of differentiated instruction that is based on learning styles of the student. The most important factor, according to Abel, was Executive Leadership and Support (Abel, 2005, p. 75).

Using the experiences accumulated by the Instructional Media and Design Department of Grant MacEwan College, Wright (2003) published an article relative to online learning in which he established several criteria for evaluating such courses. His

categories include the following: General Information, Accessibility, Organization, Language, Layout, Goals and Objectives, Course Content, Instructional or Learning Strategies, Learning Resources, Evaluation, and Overall (Wright, 2003, pp.1-10). The focus of his criteria is based on the mechanics of the course and not on the quality of content. This is illustrated by such statements as "Learners are directed" or "Learners are informed" or "Learners are told." The issue of student learning styles is not mentioned (Wright, 2003, pp. 2-7).

The Center for Teaching and Educational Technologies (CTET) at Royal Roads University conducted a pilot project to evaluate the quality of its online courses. According to Chao, Saj, and Tessier (2006), their literature review identified the following categories as necessary components of standards for online course evaluation: "Institution support, Course development and instructional design, Teaching and learning, Course structure and resources, Student and faculty support, Evaluation and assessment, Use of technology, E-learning products and services." (Chao, et al., 2006, ¶ 8)

They discovered that checklists, even though they varied from one institution to another, contained one or more of the above categories (Chao, et al., 2006, ¶ 8). However, they felt that there is a significant deficit in the ability of any of the instruments to measure the true quality of the course. The checklists suggested items to be reviewed but do not provide substantive means for further assessment of the quality of the online course (Chao, et al., 2006, ¶ 9). Having acknowledged their frustration with the various checklists, the authors, who were part of CTET, proceeded to develop an instrument that measures the quality of online courses in relation to specific standards such as course

learning outcomes aligned to program outcomes and competencies, instructional strategies aligned with learning outcomes, etc. Additionally they included feedback so that continuous improvement of the online course might occur. They devised a framework that has six components: curriculum design, instructional design, web design, teaching and facilitation, learning experience, and course presentation (Chao, et al., 2006, ¶ 10). Their thinking was that if any one of the pieces of their framework was missing, the online program was flawed. They tested their framework on 18 courses and found that 16 of the courses met the instructional design standard (Chao, et al., 2006, ¶ 37). A feature of the program is that the curriculum design component is based on a policy of curriculum quality developed by their institution, Royal Roads University (Chao, et al., 2006, ¶ 11). A second feature is that the learning component addresses students' learning style (Chao, et al., 2006, ¶ 15). The team completed the pilot project after five months and met its goals. The conclusion was that the project was a good first start and that more work needed to be accomplished (Chao, et al., 2006, ¶ 55).

A slightly different approach was taken by Swan (2003) as she addressed the issue of learning effectiveness. In her opening remarks she stated:

> …learning effectiveness must be the first measure by which online education is judged. If we can't learn as well online as we can in traditional classrooms, then online education itself is suspect, and other clearly critical issues, such as access, student and faculty satisfaction, and cost effectiveness are largely irrelevant. (p. 14)

Through her research, Swan (2003) identified three types of student interactions necessary for learning to take place and suggested the incorporation of them in the development of a quality online course was necessary. The first interaction is with content—understanding the major concepts or the big ideas in the materials. The second interaction is with instructors—written communication back and forth between the instructor and student, as well as feedback on completed work. The third interaction is with peers/students within the class—peer reviews conducted on discussions, debates, and group work on projects (p. 16).

Swan (2003) continued her discussion on the importance of the concept known as personalization in which some students do better in an online environment if the instruction is personalized for the student. She referred to a symposium, sponsored by Pew Research Center, where the participants of the symposium, faculty and administrators, identified five features that related to personalization or individual instruction. Those features include "an initial assessment of each student's knowledge of the subject at hand and the learning style of the student; an array of interactive materials; individualized study plan; continuous assessment; and varying human interaction" (p. 20). Swan suggested that there is a fine line between individualized study and social learning. If there is too much individualization, then it is at the expense of socialization (p. 20).

Cognitive Styles or Learning Styles

For the purposes of this paper, it was necessary to understand the difference between the terms cognitive style and learning style. Probably the biggest hurdle in

understanding the differences between the two terms is arriving at common definitions. Some researchers have identified learning styles and cognitive styles as being interchangeable. Others have defined cognitive styles as a subset of learning styles. In some cases the definition depended on whether the text consulted had a psychological emphasis to it, in which case cognitive style was identified as the foundation of learning.

Merriam, Cafarella, and Baumgartner (2007) took an extensive look into the differences between cognitive style and learning style. They agreed the differences in definitions in the research field are rather confusing because some researchers interchange the two words. For example they found that some researchers use cognitive style as an all encompassing term whereas others use learning style as an inclusive term. They found there is no common view for the two terms (Merriam, Cafarella, & Baumgartner, 2007, p. 406). It is necessary to review both terms and come to a clearer understanding of definitions for each in an effort to lessen any confusion. The purpose for this section is to define both terms and specify which term will be used in this study.

Definition of cognitive style. Probably the most definitive distinction can be found in a book by Merriam et al. (2007).

> Cognitive styles are characterized as consistencies in information processing that develop in concert with underlying personality traits. They are reflected in "how individuals typically receive and process information" (Joughin, 1992, p. 4) and encompass the ways people see and make sense of their world and attend to different parts of their environment. (Merriam et al., p. 406)

The implication in this definition is that each person is different and has his or her own unique personality traits. Based on this each person has an individual method of accepting information relative to his or her personality, organizing it in his or her own mind, and applying it. According to the author, it is not how the material is transmitted from the sender to the receiver that affects learning, but how the individual processes the information once it is in his or her brain (Merriam et al., 2007, p. 407).

This concept was supported by Klausmeier (1985) in his definition when he stated that cognitive style is the "preferred way of reacting to environmental stimuli" (Klausmeier, 1985, p. 135). Munro (2003) summarized cognitive style as a way of thinking, reasoning, or solving problems. He believed that consistent repetitive patterning is necessary in the processing of information based on two styles: information processing—the manipulation dimension, and information coding—the representation dimension (¶ 4).

Cognitive style was defined by Prichard (2005) as a particular approach to problem solving based on the intellect (p. 53). Thomas DeBello (1990), in his research on learning styles, cited Dr. James Keefe, Director of the National Association of Secondary School Principals' (NASSP) Learning Styles Task Force, who stated in a broad definition: "Learning styles are the characteristic cognitive, affective, and psychological behaviors that serve as relative stable indicators of how learners perceive, interact with, and respond to the learning environment" (p. 203).

Svinicki (2004) proposed that the best way to understand how post secondary students learn is to understand the cognitive theory of learning. In her research of psychological literature, she embraced the Jean Piaget concept of cognition: process the

information, compare it to existing information, evaluate the information, and either accept it or modify it (p. 11).

Liu and Ginther (1999) also agreed that there is confusion in the definitions of learning styles versus cognitive styles as the terms seem to be used interchangeably. They concluded that "cognitive styles are more related to theoretical or academic research, while learning styles are more related to practical applications" (¶ 4).

Definition of Learning Style. Learning style seems to be more closely aligned with how the receiver gets the materials than cognitive style. The most common delivery method used in education today is VAK–Visual, Audio, and Kinesthetic. A visual learner needs to see the material, an audio learner needs to hear the material, and a kinesthetic learner needs to touch the material. Prichard defined learning style as "a particular way in which an individual learns" (Prichard, 2005, p. 53). Many researchers quoted Dunn and Dunn for a definition of learning style. For example, Klausheimer said the Dunn and Dunn refer to learning styles as needs and preferences when learning (as cited in Klausmeier, 1985, p. 133).

The dilemma in education is that, as with cognitive style, there is no clear cut definition for learning style. At least three or four different definitions are listed in most books that address the subject of learning style. Prichard (2005) started his chapter on learning styles with a definition, and then proceeded to describe the four different learning styles of the Honey-Mumford Model: activist, reflector, theorist, and pragmatist. Activists are hands-on learners, reflectors prefer to watch and then try the task on their own, theorists compile all their observations and then assess the different ways a task can be accomplished, and pragmatists are problem solvers (Prichard, 2005, pp. 55-56).

However, there is no reference to how the brain processes the information. Instead they reference how the information gets to the individual or how the individual receives it. The activists have to touch the material; the reflectors have to watch the process; the theorists gather the information, evaluating how that information changes the original information; and the pragmatists look for the best way to use the information.

Merriam et al. (2007), in their literature review, found that the term "Learning style 'attempts to explain learning variation between individuals in the way they approach learning tasks' (Toye, 1989, pp. 226-227)" (as cited in Merriam, Cafarella, & Baumgartner, 2007, p. 407). Merriam et al. (2007) has concluded that the cognitive styles have their origins in the clinical laboratory whereas the learning style models are the domain of the educators who try to explain the differences in various student's ability to learn (p. 407).

Learning Style Inventories

There are many inventories to identify student learning styles. Each learning style inventory has a slightly different focus, although many overlap. Consequently it becomes difficult to decide which learning style inventory to consider when conducting research. This section of the literature review will examine several different learning style inventories. The task is to narrow down these inventories to a single learning style inventory that has credibility and validity in the research community and closest application to this research.

Diaz and Cartnal (1999) examined whether the learning style of the student was used as a basis to compare online courses to an on-campus class. Their interest was the

development of a quality online course. They reviewed several learning style instruments and felt three requirements were necessary in the selection of a learning style instrument for online classes: the instrument must be selected based on the planned use of the data collected, the instrument selected must match its planned use, and the most suitable instrument must be selected (¶ 15). Their concern with online courses was the lack of eye-to-eye socialization. They considered the Canfield Learning Styles Inventory (CLSI) (¶ 16) but dismissed it as being too narrow in its scope because it restricts the learning styles to just one or two dimensions even though their inventory considered the social dynamics present in an online classes. Diaz and Cartnal felt that the Kolb LSI had the same problems, that it is too narrow in its range and limits the learning styles to one or two dimensions when other possibilities exist (¶ 16).

Diaz and Cartnal (1999) chose the Grasha-Reichmann Student Learning Style Scales (GRSLSS). In defense of it, they stated that the scale was designed specifically for senior high school and college level students. As a relevant scale, it focused on the interrelationship of the students with the instructor and other students (¶ 17). Diaz and Cartnal suggested the learning style most suited to online students would be different from that of the on-campus students. The online students would be more self-reliant and motivated by factors other than the reward system of the on-campus class (¶ 35). From the observations of Diaz and Cartnal, there was little or no student/instructor or student/student interaction online.

Cassidy (2004) found in his research that there was no clear cut definition of learning style and that the ambiguity in the definitions caused problems for the researcher. He created a table that lists 23 models, the result of the work done by three

sets of researchers: (a) Curry, (b) Riding and Cheema, and (c) Raynor and Riding. The first model, called the Curry Onion Model, compares learning style to an onion. It has inner and outer layers: instructional preference, social interaction, information processing, and cognitive personality (p. 423). Instructional preference, the outermost layer, is described as the student's choice of a learning environment. Next, the social interaction layer identifies the student's preferences for socialization during learning such as collaborative work or non-collaborative work. The third layer, information processing, describes how the student processes information. The innermost layer, cognitive personality, defines the personality dimension of student learning. Seven other learning style inventories fall into the information processing category of the Curry Model (pp. 422-423).

The second model, the Riding and Cheema Model, has two dimensions. The first, the wholist-analytic dimension, identifies the way the student ingests information, either in its sum total state or as broken into component parts. The second dimension, the verbaliser-imager dimension, identifies how the students represent the information in their minds, either as words or as images. None of the information processing inventories were referred to for this model (Cassidy, 2004, p. 423).

The third model, the Rayner and Riding Model, has three dimensions: (a) personality-centered, (b) cognitive-centered, and (c) learning-centered. The personality-centered dimension is rooted in the Myers Briggs Inventory. The cognitive-centered dimension is based on learner differences in cognitive and perceptual functions. The learning-centered dimension involves the differences in process based models, preference based models, and cognitive skills based models. The process based models are based on

information processing. Fourteen learning style inventories are listed in the learning-centered dimension (Cassidy, 2004, p. 424).

The Curry Model's seven information processing inventories are identical to the Rayner and Riding Model learning-centered inventories, which are the following: Kolb LSI; Honey and Mumford LSQ; Vermunt LSI; Entwistle and Tait instrument; Biggs et al. SPQ; Schmeck et al. ILP; and Hunt, Butler, Noy, and Rosser instrument. The other 16 instruments are listed in the cognitive category (Cassidy, 2004, p. 422).

Tsianos, Germanakos, Lekkas, and Mourlas (2007), subdivided the learning style models based on Curry's Onion Model into three categories: (a) cognitive personality style, (b) information processing style, and (c) instructional preferences. The information processing category has the following learning style inventories: Kolb LSI; Honey and Mumford LSQ; Gardner's Multiple Intelligences; and McCarthy's 4MAT model. When using the same basic method for characterizing the learning style inventories, Tsianos identified differences (Tsianos et al., 2007, pp. 3-4). The learning style inventories that both Tsianos and Cassidy agree on are the Kolb LSI and the Honey and Mumford LSQ.

DeBello (1990) addressed eleven different theorists and their learning style inventories. He created a table that lists the theorists and the elements of their model (see Table 1). He does not divide the theorists into either cognitive style or learning style. From the elements listed, however, it can be surmised into which of the two categories they would fall (DeBello, 1990**,** p. 204).

Table 1

Theorists and Models

Theorist	Elements of model
Dunn & Dunn	Environmental, emotional, sociological, physical, psychological
NASSP	Environmental, emotional, sociological, physical, psychological/cognitive, study skills
Hill	Qualitative/theoretical symbols, modalities of inference, cultural
Letteri	Cognitive style
Ramirez	Bicognitive style, bicultural
Reinert	Perceptual modalities
Schmeck	Cognitive processing, study methods, retention
Hunt	Need for structure, need for authority dependent/independent
Kolb	Concrete experience vs. reflective observation/abstract conceptualization vs. active experimentation
Gregorc	Perception/ordering
McCarthy	Innovative/analytic/common sense/dynamic hemisphericity

Note. Items in Table 1 are from Comparison of Eleven Major Learning Styles Models: Variables, Appropriate Populations, Validity of Instrumentation, and the Research Behind Them by Thomas De Bello, 1990. *Journal of Reading, Writing, and Learning Disabilities, International*, p. 204.

A factor that needed to be addressed was the education level at which the learning is expected to take place. This study was concerned with online learning at the postsecondary level, eliminating any pedagogical issues related to the elementary and secondary levels. Since the purpose of this study is to examine postsecondary and adult learners, based on the information given, most of the inventories DeBello reviewed, except for the Schmeck, Hunt, Kolb, and McCarthy, would be eliminated because they do not address learning style or are for the wrong age group. The McCarthy model, based on the Kolb LSI, turns to brain functioning and how the brain handles the material. Therefore this model has been eliminated since it strayed from what is considered to be the definition of learning style and appeals more to the cognitive style (DeBello, 1990, p. 204).

If the information is taken from the Cassidy study and compiled into a separate comparison table, some consensus is found. Of note is the agreement by all three research studies on the Kolb LSI as related to the means of identifying the learning style of an individual. On the other hand, Tsianos, et al. (2007, p. 4) and Cassidy (2004, p. 432) agree on the Honey and Mumford Inventory, while Debello (1990, p. 204) and Cassidy (2004, p. 434) agree on the Hunt and the Schmeck Inventories.

Analysis of the Four Chosen Inventories

After the literature review to determine a definition of learning style, the field of inventories was narrowed down to four: the Schmeck Inventory, the Hunt Inventory, the Honey and Mumford Inventory, and the Kolb Inventory. Merriam et al. (2007) gave a word of caution in their work. They suggested that it was important that the researcher

consider the intended use of the inventory based on the designer's definition of learning style (Merriam, Cafarella, & Baumgartner, 2007, p. 409). Therefore considering this caution, it seems appropriate to review the four learning style inventories before passing judgment on the one to be incorporated into this paper.

Schmeck inventory. In 1977 Schmeck brought to fruition the Inventory of Learning Processes (ILP). It was designed to evaluate learning style based on four scales. After a study of all four scales, it becomes apparent that the ILP was designed to assess the cognitive functioning of deep thinking, encoding information, and detailed attention to facts. Consequently, this inventory would be considered an identification of the cognitive style of a student and not the learning style. Cassidy (2004, p. 434, Schmeck & Grove, 1979, p. 43) supported this opinion as he categorized it as a cognitive inventory. Because of this, the Schmeck ILP was discarded as an instrument for this paper.

Hunt inventory. The Hunt Conceptual Level Model was developed in 1978. Cassidy's analysis of the Hunt Model suggested that the method of presentation of the materials for high conceptual level students had no impact on learning. Cassidy related that this model also appears to be a cognitive style inventory (Cassidy, 2004, p. 435). This cognitive relationship of levels of learning to authority and discipline are not what is being measured in this study, and, therefore, the Hunt Model was discarded.

Honey and Mumford inventory. The third inventory, the Honey and Mumford Learning Styles Questionnaire (LSQ), was developed in 1992. It has as its base the Kolb experiential learning model (Cassidy, 2004, p. 432). Since the Honey and Mumford LSQ replicates the Kolb LSI, it does not make any sense to use an imitation, and, therefore, the LSQ will not be used in this study.

Kolb inventory. Kolb has been recognized as a leader in the education field with the development of his Learning Style Inventory (LSI). It was developed based on his study of Kurt Lewin, John Dewey, and Jean Piaget. The premise of their work was based on experiential learning. Kolb was primarily influenced by Piaget's theory that a direct relationship exists between intelligence and experience (Kolb, 1984, p. 12). Piaget's main premise was that learning was a balance between the process of accommodation of concepts to experience and the assimilation of events and experiences into concepts. Postsecondary/adult learners, who come to the learning environment with many experiences, are placed in a conflict situation when presented with new ideas that are different from their experience database. The student has three choices: (a) assimilation—to accept the new idea and incorporate it into the experience database; (b) accommodation—to accept the basic idea, but modify it to fit the experience database; (c) avoidance—to not accept the new idea and reject it completely (O'Donnell, Reeve, & Smith, 2009, pp. 81-83). A block diagram of Piaget's premise would be similar to the following graphic (see Figure 3).

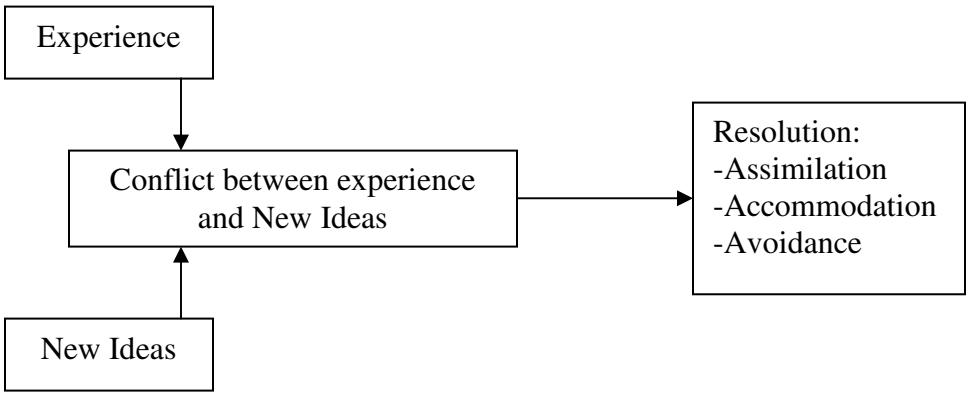


Figure 3. Block diagram of Piaget's concept (O'Donnell, Reeve, & Smith, 2009, p. 84).

Kolb has described learning as a process based on experience. He views it as a continuous loop consisting of four modes of learning. The loop starts with the first mode of learning which is concrete experience (CE). As new ideas and concepts are presented, the learner goes through a stage of reflective observation (RO). From there the learner moves into the stage of abstract conceptualization (AC) and finally on to testing the new ideas through active experimentation (AE). Kolb called these adaptive learning modes. The idea of conflict between two opposing concepts comes from the fact that concrete experience is opposite from abstract conceptualization, and active experimentation is opposite from reflective observation. The concrete/abstract learning mode is known as "prehension" or the ability to understand the idea or concept physically or mentally. If obtained physically, it is called "apprehension." If obtained mentally, it is called "comprehension" (Kolb, 1984, p. 41) (see Figure 4).

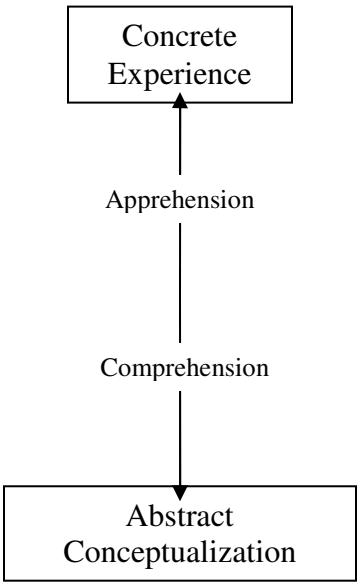


Figure 4. Concrete Experience versus Abstract Conceptualization (Kolb, 1984, p. 42).

Note. From *Experiential Learning: Experience as the Source of Learning and Development* (p. 42), by D. Kolb, 1984, Upper Saddle River: Prentice Hall. Copyright 1984 by Prentice Hall. Adapted with the permission of Pearson Education, Inc., Upper Saddle River, NJ.

The diametrically opposed learning modes of active experimentation and reflective observation are part of the process of transformation where "knowledge is created through the transformation of experience" (Kolb, 1984, p. 41). If the reflection is done internally, it is called "intention." If it is done through actively working with the materials, hands-on, it is called "extension" (Kolb, 1984, pp. 40-43) (see Figure 5).

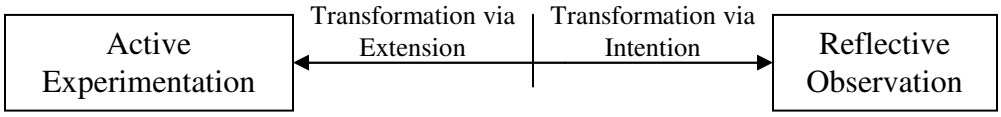


Figure 5. Active Experimentation versus Reflective Observation (Kolb, 1984, p. 42)

Note. From *Experiential Learning: Experience as the Source of Learning and Development* (p. 42), by D. Kolb, 1984, Upper Saddle River: Prentice Hall. Copyright 1984 by Prentice Hall. Adapted with the permission of Pearson Education, Inc., Upper Saddle River, NJ.

Kolb stated that learning occurs from the transformation of experience and that transformation of experience occurs through the relationship between prehension and transformation; therefore, learning occurs through grasping experience and transforming it (see Figure 6). Since there are two transformation categories and two prehension categories, there are four possible combinations. If experience is obtained through apprehension and changed through intention, it is known as "divergent knowledge" (CE + RO). If experience is obtained through comprehension and changed through intention,

it is known as “assimilative knowledge” (AC + RO). If experience is obtained through comprehension and changed through extension, it is known as “convergent knowledge” (AC + AE). And finally, if experience is obtained through apprehension and changed through extension, it is known as “accommodative knowledge” (CE + AE) (Kolb, 1984, pp. 40-43).

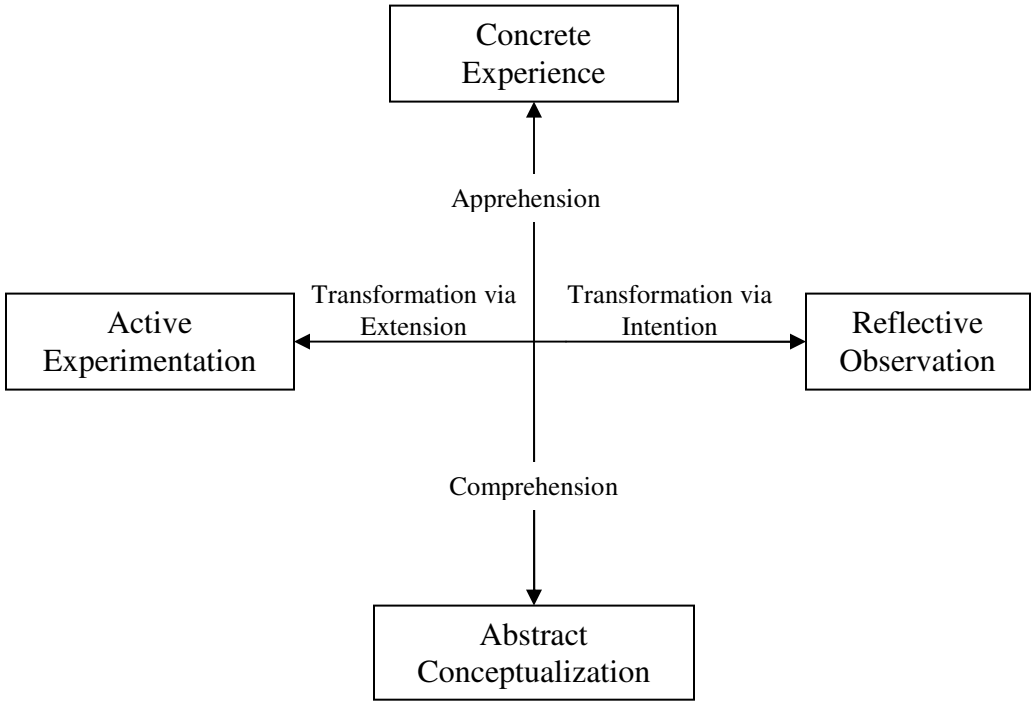


Figure 6. Superimposed Prehension versus Transformation (Kolb, 1984, p. 42).

Note. From *Experiential Learning: Experience as the Source of Learning and Development* (p. 42), by D. Kolb, 1984, Upper Saddle River: Prentice Hall. Copyright 1984 by Prentice Hall. Adapted with the permission of Pearson Education, Inc., Upper Saddle River, NJ.

Table 2 depicts the relationships established with the four categories. Each one has a specific set of characteristics associated with it.

Table 2

Learning Style Matrix

Transformation / Prehension	Active Experimentation (AE)—doing	Reflective Observation (RO)—watching
Concrete Experience (CE)—feeling	Accommodative (CE + AE)	Diverging (CE + RO)
Abstract Conceptualization (AC)—thinking	Converging (AC + AE)	Assimilating (AC + RO)

Note: From *Kolb Learning Styles.* 2006. Retrieved March 16, 2008 from http://www.businessballs.com/kolblearningstyles.htm.

The first learning style is called accommodating and is a cross of concrete experiences transformed by active experimentation. People characterized as accommodators are social in nature. They like the hands-on approach and are willing to take risks (Kolb, 1984, pp. 77-78). They prefer group work, thus relying on information from others (Schaller, Borun, & Allison-Bunnell 2007, p. 2). Additionally these individuals are problem solvers who ask the question "What if?" The instructor should allow these students free reign to discover things by themselves (Conner, 2007, ¶ 11).

The second learning style is titled diverging, and people with this type of learning style are called divergers. Here the prehension of concrete experience is transformed by reflective observation. These people are creative by nature and prefer to work in groups (Schaller, 2007, p. 3). They have a good imagination and will view concrete experiences from different viewpoints. Divergers are good at brainstorming and are interested in people (Kolb, 1984, pp. 77-78). Additionally, these individuals want to know how course materials relate to them, their experience, and their future careers. They would ask the question "Why?" The instructor of this class needs to be a motivator (Connor, 2007, ¶ 11).

The third learning style is called converging, and people with this type of learning style are called convergers. Here the prehension of abstract conceptualization is transformed by active experimentation. These people are practical by nature and do not like group work (Schaller, Borun, & Allison-Bunnell, 2007, p. 3). They are good problem solvers and do best on multiple choice tests where there is only one correct answer. They are not very social people and prefer working alone (Kolb, 1984, pp. 77-78). These individuals ask the question "How?" They like distinct and clear tasks and learn through experimentation and failure. The instructor of these students needs to function as a coach and provide a lot of feedback (Conner, 2007, ¶ 11).

The fourth learning style is termed assimilating, and people with this type of learning style are called assimilators. Here the prehension of abstract conceptualization is transformed by reflective observation. These people are intellectuals by nature and do not like group work (Schaller, Borun, & Allison-Bunnell, 2007, p. 3). They have the ability to create theoretical models through inductive reasoning and are less focused on people

and more on concepts (Kolb, 1984, pp. 77-78). These individuals would ask the question "What?" They like information that is organized logically such as PowerPoint presentations. The instructor should function as the expert with these students (Conner, 2007, ¶ 11).

Larkin and Budny (2005) listed the characteristics of each type of student in Table 3. The table provides some specific characteristics for use in developing courses where the student's learning style is considered. For example, theoretically, if the majority of the class tends to be assimilators or convergers, then group work for them would not work out very well. On the other hand, if the majority of the class tends to be accommodators or divergers, group work would probably enhance learning since these learners like to share ideas and concepts with one another. The accommodators and divergers are the ones who prefer social interaction through group work (Larkin & Budny, 2005, p. F4D-5).

Table 3

The Four Quadrants of the Kolb Learning Cycle

Accommodators (Type IV) WHAT IF?	**Divergers (Type I) WHY?**
• Likes problem solving. • Enjoys taking risks. • Prefers to learn through exploration. • Can synthesize information easily. • Self-discoverers. • Brainstorming (especially in groups). • Creators of new things. • Formulators (of many problem types). • Users of information to solve problems. • Communicators of concepts to others.	• Big picture people. • Relies on feelings. • Prefers personal interaction. • Learns by discussion (likes group work). • Sharers (especially spontaneous thoughts). • Good at generating ideas and alternatives. • Brainstorming. • Enjoys peer reviews. • Uses emotion when making decisions.
Convergers (Type III) HOW?	**Assimilators (Type II) WHAT?**
• Quickly cuts to the chase. • Doesn't like to waste time. • Likes to discover, test, and try new things. • Likes to take things apart and see how they works. • Learns by doing (labs work well). • Does not like lectures. • Quick to make decisions. • Searches for one correct answer. • Does not prefer group work.	• Comprehension is critical. • Strength in analyzing, organizing, and sorting. • Likes to evaluate pros and cons. • Likes information for information's sake. • Enjoys lectures. • Likes synthesizing parts (doing research). • Likes order. • Works to avoid errors using lists to retrieve ideas and information. • Uses logical and detailed thinking. • Does not prefer group work.

Note. Information contained in Table 3 was obtained from *Learning Styles in the Classroom: Approaches to Enhance Student Motivation and Learning* by T. Larkin and D Budny, 2005, ITHET 6th Annual International Conference, Session F4D, p. F4D-5. Copyright 2005 by IEEE. Downloaded on July 20, 2009. Authorized licensed use limited to Ed Perantoni.

Schaller, Borun, Allison-Bunnell, and Chambers (2007) used the Kolb experiential learning theory in their research. They were interested in learning style as it relates to adults and children. In their study, they relabeled the Kolb model identifying accommodating as social, diverging as creative, assimilating as intellectual, and converging as practical. Schaller et al. characterized social learners as leaders who learn

by problem solving in groups. They learn from one another and prefer hands-on methods for solving problems (Schaller, et al., pp. 2-3). For Schaller et al., social interaction is associated with the accommodator.

Lastly, one issue needs to be addressed and that is the reliability of the Kolb LSI. Whyte, Karolick, and Taylor (1996) examined the reliability of this inventory. They considered reliability as it related to the consistency of the answers obtained from the LSI. They reported that there is a strong internal consistency as measured by Cronbach's Alpha coefficients. The values ranged from 0.82 for concrete experience, to 0.83 for abstract conceptualization, to 0.78 for active experimentation, and to 0.73 for reflective observation (Whyte, Karolick, & Taylor, 1996, p. 788). Since the scores are 0.70 or greater, that indicates a strong internal consistency within the exam each time it is taken. In other words, when the exam is given over and over, typically, the same questions will be missed by the same students.

Summary

The research indicates a multitude of reasons for online course attrition including poor locus of control, personal and/or family related problems, job-related conflicts, low GPA, low satisfaction with the course, poor technological skills, lack of any socialization, and to low motivation. Dropout rate, as defined in the literature, appears to be a function of some "flaw" within the student or some difficulty the student encounters in his or her relationship to the course. Some social/personal issue prohibits the continution in the online environment.

Student attrition from online courses often involves program issues. The attrition reason reported most frequently is the lack of feedback from the professor over course work completed by the student. The teacher's role in the online course, or lack thereof, is given very little attention in the studies. While most students can interact with the teacher and other students relatively easily in the traditional "bricks and mortar" class, it is not clear if that same interaction is available for students in an online class. Based on some of the literature search, it can be summarized that researchers determined that interaction with the professor is a necessary element for some students in the learning process. Consequently it seems that this interaction with the professor should be an important part of the design process of a quality online course to facilitate learning.

Much of the literature revealed that there are many checklists for use in evaluating the quality of online design but none can be used to define in detail the credibility of a specific course's meeting standards of quality. The majority of the information relates more generally on a larger scale to either a program or an institution. Quality checklists for the program level address issues such as cost effectiveness of a program or administrative support for faculty or technical support for the student or web page design. On the other hand, a few checklists were found for the course level which address the elements of the design of an online course and include factors like learning style. The Sloan Consortium, NACOL, Chao et al., and Karen Swan all showed that it was important that the student's learning style be identified and considered in the development of an online course. The literature seems to show that it is quite possible that some of the student attrition from online courses could be prevented by considering each students' learning style.

There is a lack of uniform information on quality, due to, perhaps, confusion over the terms “learning style” and “cognitive style.” For the purposes of this study, the two terms were examined in light of educational goals and not psychological parameters. While cognitive style is often viewed as how the brain processes the information, learning style is often viewed as how the information gets to the student’s brain. It was decided this narrow definition of learning style allows for a clearer understanding of how a student gains knowledge and was chosen as the definitive application to be used in this study.

Many researchers have developed instruments to identify the student’s learning style. Four inventories were identified as potential candidates for this study and three of them were eliminated because the goals of the instruments and the definition of the parameters did not meet the requirements of this study. The remaining inventory, the Kolb LSI, was selected because it met the criteria.

The categories of students considered in this study are both postsecondary and adult learners meaning that they come into the course with a definite experience base that can often conflict with new material presented. Much of the research shows that experiential learning is very successful with post secondary and adult learners. Experiential learning becomes the starting point for the learning style.

The most recognized researcher in the field of experiential learning is Kolb. Based on the research, his Learning Style Inventory has been used in this study to determine success/failure rates with select groups of students. Learners characterized by Kolb as having accommodating or diverging learning styles learn best when interacting with others in the class and they prefer group work. The intent is to show how an

accommodator and diverger perform in an online class when tasked to complete an assignment as a group project.

Chapter Three—Methodology

Introduction

This chapter concentrates on the mechanics of the research process. Also addressed in this chapter are the research questions, the research perspective, a description of the participants in the study, the instruments that were used, the procedures that were followed, and how the data were analyzed in this study. Finally the issues of bias and internal validity are considered in this chapter.

Purpose of Study

The purpose of this study was to show that success for some learners in an online course is related to the social interactions of students with each other in the class. This social interaction appears to be a characteristic of certain learning styles of students. The identification of the learning style of each student in an online class may provide the course designer with the tools necessary to construct a quality online course that addresses the needs of the student.

To accomplish this purpose, the learning style of each student was identified and then compared to performance scores via a pretest/posttest to establish the presence or lack of improvement. Control groups were used to establish baseline improvement scores. The variable of group work was incorporated into the experiment groups. Then the mean improvement score for the Experimental group was compared to the Control group to arrive at a conclusion about the hypothesis–to either validate it or reject it.

Research Questions

Several questions were addressed in this study:

- Were accommodator or diverger student (learns well with group interaction) performance scores significantly lower or higher than the rest of the class?
- Were the assimilator or converger student (does not learn well with group interaction) performance scores significantly lower or higher than the rest of the class?
- Did the group work offered in each experimental group class have a significant impact on the performance scores?
- Were the reasons that students did not successfully complete the course due to technical limitations, personal issues, process issues, or course design issues?
- Were performance scores attributed to other factors such as age, gender, or ethnicity?
- Were there any biases in the data or data collection process that might have a serious impact on the overall results of the study?

Research Perspective

This study incorporated both quantitative and qualitative methods. The quantitative portion addressed the accommodator/diverger issue relative to performance scores based on group work. Quantitative data were collected based on pre-test scores, posttest scores, and learning style type. The qualitative portion of the study addressed the reasons a student did not successfully complete the course which were collected via a personal interview.

Type of Research

The study that was conducted herein was a quasi-experiment. The subjects had not been selected at random; therefore, the study did not fit the definition of a true experiment. There were control groups and experimental groups. The subjects came from classes for which they registered. The subjects in all the classes were given an option to participate in the study or to not participate. Those participating signed a letter of acceptance (Appendix A). Eight classes, four meteorology and four criminal justice classes, taught by two different professors were used in the study.

Context and Access

The study was conducted at Lindenwood University during the Fall of 2008 and Spring of 2009. Lindenwood is a private university, located in St Charles, MO, that offers liberal arts degrees, preprofessional preparation, Masters Degrees, and doctorates. It is committed to the success of the students.

Table 4

List of Courses Used in the Study

Fall 2008 – Control Group Classes	Spring 2009 – Experimental Group Classes
ESC11011 Meteorology	ESC11011 Meteorology
ESC11012 Meteorology	ESC11012 Meteorology
CJ20012 Criminology	CJ20012 Criminology
CJ200OL Criminology	CJ200OL Criminology

The standard bricks and mortar type courses were ESC11011 and CJ20012. They met in classrooms on campus. The classrooms were configured for high technology equipment such as projectors, computers, DVD players, VCR players, and digital overhead projectors. All course materials for these two courses were placed on WebCT, a course delivery platform for both intranet and online modes. Both classes had streaming video of the lectures. If a student was absent from the class, he or she could download the video and watch the lecture. Tests were administered in the classrooms and consisted of multiple choice questions and essays.

The online courses were ESC11012 and CJ200OL. The students in ESC110012 attended orientation sessions the first two classes for an introduction to the course and the online format using WebCT, Version 6. Students in CJ200OL were given an introduction online via WebCT, Version 6. These two courses were exact duplicates of the bricks and mortar classes including the streaming video of the lectures. The same two professors taught both the online and the bricks and mortar courses.

The professors of both courses used the pretest/posttest method to evaluate the progress of the student. The intent of the assessment method was to evaluate the need for improvement in content delivery. If the mean score for the assessment objectives for the meteorology classes fell below 50% on the posttest, then the method of presentation of the content was evaluated to see if improvement was needed. This method was used in this study to determine those areas where content delivery needed to be changed. The experimental groups were assigned a group project for those courses in which the course objectives fell below 50% for the fall 2008.

Participants in the study

The subjects for the quantitative portion of the study were students who registered for the classes and signed a statement agreeing to participate. Selection for the study was not based on age, gender, or ethnic identity; however, those demographic variables were analyzed. The selection process for the study was not random, and, therefore, no sampling procedure was needed. A learning style inventory was administered the first day of class and students were categorized by learning style. A pretest was administered to set a reference point for student knowledge relative to the subject area.

Group work was completed during the spring 2009 semester. The list of students was sorted by learning style. Then, using a random number generator, students were selected and placed in a group based on their learning style. Seven groups of five students were established by learning style. The eighth group was a mix of students who were grouped together without regard to learning style.

WebCT Version 6 was the platform used to present content material. Many of the subjects had experience with WebCT; however, this was their first exposure to the content material of the classes. For most students enrollment in the classes in this study was their first exposure to the two professors.

Data Collection

The first day of class the students were presented with the opportunity to participate in the study. The process was explained in detail with the caveat that participation or nonparticipation in the study would not have an impact on their grade.

They were given the opportunity to sign the consent to participate letter. Then the students were given the demographic survey and asked to complete it and turn it back in. The Kolb LSI was administered. The pretest was administered the first day of the class and the posttest was administered to the students at the end of the semester. The questions on it were the same ones as on the pretest. The answers were put on a separate answer sheet and turned in upon completion.

Methods Used to Collect Data

The Kolb LSI was administered to the subjects on the first day of class. The subjects completed the twelve sentences and submitted the form to the instructor. The information on the form was transferred to the learning style grid for the determination of the learning style. Permission for use of the inventory and the scoring grid was obtained from the Hay Group (Appendix C)

The pretest/posttest for meteorology was used to determine the performance of the students enrolled in the Meteorology courses. This test was developed by the professor with help from a working group of educators and students and has been used for approximately six years. It has been used to identify areas of weakness in the students' knowledge and to allow for modification of the content of the course the following semester.

The pretest/posttest for criminal justice was used to determine the performance of those students enrolled in the Criminology course. This test was developed by the faculty of the Criminal Justice discipline and was used to identify areas of weakness in the students' knowledge and allow for modification of the content of the course the following

semester. Additionally, subjects in the Criminology online courses were asked to complete a course evaluation at the end of the semester. This evaluation was used to determine any weaknesses in the students' use of WebCT as a platform for an online course. The intent was to identify areas requiring stronger technical support systems for the users of WebCT.

Instruments Used To Collect Data

Demographic survey. The demographic survey included questions regarding gender, age, college major, year in school, and ethnicity. This survey was locally generated and used as part of the data analysis. The intent was to see if other factors than just learning style had an impact on student success in the classes.

Kolb LSI. The Kolb LSI was obtained from the Hay Group. Permission was sought to use it in a research project. The Hay Group permitted its use under the condition that it not be published in the dissertation. See Appendix C for the letter of consent. The LSI has twelve questions that must be answered with four preferences. Those preferences range from: most like you, second most like you, third most like you and least like you (Kolb, 1993, LSI). The reliability of the Kolb LSI has been determined to have a strong internal consistency as measured by Cronbach's Alpha coefficients. The values ranged from 0.82 for concrete experience, 0.83 for abstract conceptualization, 0.78 for active experimentation, and 0.73 for reflective observation (Whyte, Karolick, & Taylor, 1996).

Meteorology pretest/posttest. The Meteorology pretest/posttests used in this study were generated in 2000 by a task force formed to develop the questions. That task force

consisted of this researcher and three senior education majors who had a thorough understanding of Bloom's taxonomy, Maslow's hierarchy of needs, and Gardner's multiple intelligences. The instrument was developed toward the end of the semester, after the students had an understanding of the content of the course. The instrument has been used four times a year since and has produced consistent results. The results become part of the university's assessment program. The reliability of the instrument as determined by the Cronbach Alpha coefficient is 0.605 indicating an acceptable degree of reliability.

Criminal Justice pretest/posttest. The Criminal Justice pretest/posttests used in this study were generated in 2004 by faculty of the Criminal Justice discipline. The pretest/posttest is administered four times a year and the results become part of the university's assessment program. The reliability of the instrument as determined by the Cronbach Alpha coefficient is 0.699 indicating an acceptable degree of reliability.

End of course survey. The end of course survey has ten questions. It was adopted from Levy (2004) and modified for local use (Appendix D) The purpose of the survey is to determine the student's attitude toward online learning and his/her potential success in the course. The scaling of the answers is based on the Likert scale with a "1" being strongly disagree to a "5" being strongly agree. This was the first time the survey was used at this institution; therefore, it has no history of reliability.

Qualitative Study

Participants who did not successfully complete the course (dropped out of the course or failed the course) were part of the qualitative portion of the study. They were

asked a series of questions relative to their performance in the course (Appendix E). The intent was to identify why these students were unsuccessful in the course. This survey was used for both the Meteorology online classes and the Criminal Justice classes.

The instrument used to collect the data was an open ended survey that had five general questions on it that addressed the following issues: (a) student's technology capability, (b) equipment availability, (c) student's experience in the online environment, and (d) factors affecting the potential to learn or not learn in the online environment. This was the first time the survey was used; therefore, it has no history of reliability.

Procedure

In order to compare the learning style to performance in the class, each student's learning style was determined. Control groups were the baseline groups for measuring change in performance relative to the alteration of group work status. The fall 2008 online and bricks and mortar classes served as the control groups. These groups did not participate in group work in the fall 2008 semester. Both classes, online and bricks and mortar, were treated the same. The spring 2009 semester classes, both online and bricks and mortar classes, completed group projects and were treated the same.

Initial processes, fall 2009. Two meteorology classes and two criminal justice classes were used in this research project. One of the meteorology classes and one of the criminal justice classes were bricks and mortar and the other meteorology class and the other criminal justice class were online courses. The students in the online meteorology class did not know prior to the start of the course that it would be taught in the online mode, so a week prior to the start of the semester they were sent a letter stating that fact.

This gave them the option to change to the bricks and mortar class. Only one student in the fall 2008 semester meteorology dropped the class because it was being taught online. The reason this student gave for dropping the class was that he or she needed face-to-face contact with the professor, primarily for the purpose of reminders of when assignments were due. One student in the spring meteorology class switched to the bricks and mortar class after the semester had been in session for two weeks. This student also preferred the face-to-face contact with the professor. Thus, as a result of the change, the two students wanted interaction with the professor, not other students. Both students completed the exit interview.

This researcher met with the bricks and mortar meteorology class and the online class the first week of the fall 2008 semester. Forty-two students were enrolled for the bricks and mortar class, and 42 students were enrolled for the online class. The syllabus was discussed as well as expectations for the class. The students completed the Permission Form (Appendix A) allowing the researcher to collect the data. A Demographic Form (Appendix B) was completed by the students as well as the Kolb Learning Style Inventory. The third day of class, the students completed the pretest for meteorology to establish their knowledge base of meteorological concepts. At the end of the first week, the students in the online class proceeded with the course online. At the end of the semester, both classes completed the posttest and the results were tabulated. The online class was given a WebCT survey to complete. The purpose of this survey was to assess their confidence in using the online platform for learning.

The professor of the criminal justice classes met with the students in the bricks and mortar class. Twenty-eight students were enrolled for the bricks and mortar class,

and 31 were enrolled for the online class. Twenty-two students in the bricks and mortar class completed the Permission Form, Demographic Form, The Kolb Learning Style Inventory and the pretest. The students in the online class completed the Permission Form, Demographic Form, The Kolb Learning Style Inventory and the pretest. They were asked to complete the paperwork and submit it to the researcher; five students did so.

Initial processes, spring 2009. This researcher met with the students in the bricks and mortar meteorology class and the online class the first week of the spring 2009 semester. Forty-four students were enrolled in the bricks and mortar class, and 47 were enrolled in the online class. The same process for completing the paperwork was followed. Students were asked to complete the appropriate forms, to complete the Kolb learning style inventory and to complete the pretest. During the semester they were assigned two group projects. These group projects were selected based on low posttest objective scores from the fall semester. The two weak meteorology content areas identified were the structure of the atmosphere and airmasses/fronts. At the end of the first week of the semester, the students in the bricks and mortar classes proceeded with the course online. At the end of the spring semester, both classes were issued the posttest, and the results were tabulated. The online class was given a WebCT survey to complete. The purpose of this survey was to assess their satisfaction in using the online platform for learning.

The professor of the criminal justice classes met with the students in the bricks and mortar class. Thirty-seven students were enrolled in the bricks and mortar class and thirty-eight were enrolled in the online class. Eight students in the bricks and mortar class completed the necessary paperwork. They completed the Kolb learning style inventory

and a pretest. The students in the online class were presented the Permission Form, Demographic Form, The Kolb Learning Style Inventory and the pretest. They were asked to complete the paperwork and submit it to the researcher; six students did so.

Data Analysis

Data organization. The data for each class was set up on an Excel spreadsheet with six subpages. With five subpages per class, there was a total of 40 pages of data. Columns were labeled to clearly identify the parameter being collected. The data was displayed spreadsheets: Spreadsheet 1—Demographic survey/summary; Spreadsheet 2—Kolb LSI; Spreadsheet 3—Pretest; Spreadsheet 4—Posttest; Spreadsheet 5—End of course Survey; and Spreadsheet 6—Attrition Survey.

Data reduction. Columns on the Excel spreadsheets were created to allow for calculations for summations, averages, and standard deviations. The Hay group provided a formula and reference sheet for the reduction of student responses to the Kolb LSI.

Pretests and posttests were tabulated for the number of correct questions, then the posttest was compared to the pretest score and an improvement score (delta) was calculated. End of Course Surveys were tabulated by Likert number. Attrition Surveys were evaluated for commonality among the qualitative responses.

Data display. The demographic data was displayed in table form to show each category by class and then by total. The pretest/posttest scores were displayed in table form by class, by control group, and by experimental group.

Internal Validity

Careful consideration was given to all aspects of this study—administration of tests, collection of data, and treatment of data—in order to reduce any threats to the internal validity of the data. To prevent subject characteristic risks, gender, age, and ethnicity were considered in the evaluation of the final results. To eliminate a data mortality problem, only matched pair data were used. To reduce the location risk, the same room was used for each lecture on site. Any resources needed were brought to the lecture by the professor. All the course materials were installed on the WebCT platform. Instrumentation risks were not a problem as the pretest and posttest contained multiple choice questions, insuring there was no subjectivity in the grading process. Testing risk was not an issue as the pretest and posttest was given unannounced. The time period between the two tests was at least fourteen weeks. Maturation was not an issue either. While students mature as time progresses, the time period for the semester was sixteen weeks, a period short enough to minimize any significant problems. Major crises in a student's life could not be controlled; therefore, no attempt was made to change the student's position or standing in the class when a personal crises occurred. Select groups of students were not given special treatment thereby reducing the possibility of the Hawthorne Effect (Fraenkel & Wallen, 2006, p. 177). The regression threat was not an issue as the students participating in the study did not know which group was being selected to test the hypothesis. They only knew that a research project was being conducted that equated improvement in posttest score over pretest score based on learning style. Finally, no group was given better treatment than another group thereby eliminating the implementation risk. Every effort was made throughout to standardize the

process of data collection between the two semesters and classes therein. Both faculty members were aware of the problems created by data corruption.

Summary

The purpose of this study was to find out if there is a relationship between learning style, performance in a class, and the quality of the course. A carefully thought out procedure was mapped out and implemented. The Kolb LSI was administered to each student. The data collected from the LSI was used to identify the learning style of the student—accommodator, diverger, assimilator, or converger. Improvement between the pretest and the posttest was calculated and averaged for each class. Improvement was also averaged for each of the four learning styles. An ANOVA test was calculated to test the significance of the relationship between the improvement mean and the learning style. A t-test was calculated to either validate or reject the null hypothesis. Other instruments, the end-of-course survey and the attrition survey, were also administered to the students. Many tests and precautions were considered to keep the tests honest and valid.

Chapter Four—Data Analysis

Introduction

The purpose of this study was to see if there was any relationship between learning style, performance in a course, and the quality of the course. Two learning styles, the accommodator and the diverger, were the focus of the study. Students identified with those learning styles prefer to work in groups and to complete projects by discussing issues with other students or brainstorming topics. This is how they learn. It is this group work, considered part of the socialization process, that was used throughout the study to see if it affects the student's improvement score in the class. If proven, a designer of a high quality course should incorporate group work in the curriculum to meet the needs of these types of students.

The data from the criminal justice classes was not used in this study because of the low participation by the students in this research. The comparison of five online control group students to six online experimental group students would have had very little statistical significance and would not have counterbalanced any biases of the researcher. To substantiate this, a sample size was calculated given that $\alpha = 0.05$, with a confidence interval of 95% and a maximum error of estimate being within 2 points of the true mean. The following formula was used:

$$N = \left(\frac{Z_{\frac{\propto}{2}} x\, \sigma}{E} \right)^2$$

The sample size was calculated to be 31 where $Z_{\frac{\propto}{2}=1.96}$, $\sigma = 5.689$ for the control group, and $E = 2$.

To help keep the classes in the correct order, a nomenclature for each of the classes was developed rather than using the class and section number. For example, WXBMFA08 has the following meaning: WX = meteorology class, BM = bricks and mortar class, and FA08 = fall 2008 class. CJOLSP09 has the following meaning: CJ = criminal justice class, OL = online class, and SP09 = spring 2009 class. The fall 2008 classes were the control groups and the spring 2009 classes were the experimental groups. The classes are identified in the Table 5.

Table 5

Interpretation of Abbreviations for Classes Used in the Research Project

Class	Description
WXBMFA08	Meteorology, bricks and mortar, fall 2008
WXBMSP09	Meteorology, bricks and mortar, spring 2009
WXOLFA08	Meteorology, online, fall 2008
WXOLSP09	Meteorology, online, spring 2009
CJBMFA08	Criminal justice, bricks and mortar, fall 2008
CJBMSP09	Criminal justice, bricks and mortar, spring 2009
CJOLFA08	Criminal justice, online, fall 2008
CJOLSP09	Criminal justice, online, spring 2009

Cronbach Alpha Coefficient

The pretest/posttest in both the meteorology classes and criminal justice classes were developed by the professors of the respective classes. The reliability of these

pretest/posttests is unknown. Cronbach (1951) worked in the area of test reliability and developed a scale to measure that reliability. Known as the Cronbach Alpha Coefficient, the reliability is found by comparing the variance of the individual test questions to the variance of the test. One of Cronbach's premises is that test score interpretation is improved if there is a high first-factor concentration (Cronbach, 1951, p. 332). In other words if there is just one purpose for the test instead of multiple purposes being ascribed to it, then the scores, in general, will be higher. The single objective for administering the pretest was to evaluate the student's knowledge about meteorological concepts at the start of the class. The reason for administering the posttest was to evaluate the student's knowledge about meteorological concepts at the end of the class, again, a single objective.

To check the reliability of the meteorology and criminal justice pretest/posttests, a Cronbach Alpha coefficient was calculated. A coefficient of 0.70 or higher is considered high enough to verify the reliability of the test (Fraenkel & Wallen, 2006, p. 161). The formula used to calculate the coefficient is as follows:

$$\propto = \frac{N}{N-1}\left(1 - \frac{\sum \sigma^2 Y}{\sigma^2 X}\right)$$

This formula compares the sum of the variances of each individual question to the total variance of the test. The coefficients for each of the tests for each of the classes are presented in Table 6.

Table 6

Cronbach Alpha Coefficients

Class	Test	Coefficient	Class	Test	Coefficient
CJBMFA08	Pre	0.557	WXBMFA08	Pre	0.353
	Post	0.914		Post	0.846
CJBMSP09	Pre	0.489	WXBMSP09	Pre	0.431
	Post	0.603		Post	0.729
CJOLFA08	Pre	0.838	WXOLFA08	Pre	0.547
	Post	0.781		Post	0.729
CJOLSP09	Pre	0.619	WXOLSP09	Pre	0.567
	Post	0.765		Post	0.636
Mean		0.699			0.605

From a one way ANOVA calculation of the data in Table 6, the mean Cronbach Alpha of the pretest and posttests for the criminal justice classes was 0.699 and for the weather classes was 0.605.

Table 7

One Way ANOVA Analysis of the Cronbach Alpha Coefficient

Source	DF	SS	MS	F	P
Between Groups	1	0.0359	0.0359	1.437	0.250
Residual	14	0.350	0.0250		
Total	15	0.386			

Note. Normality test passed (p=0.557). The samples come from a normally distributed population. Equal variance test (F-Test) passed (P=0.951). The null hypothesis of the test is that there is no difference between the populations the test is based on, i.e., variances between the groups.

There is not a statistically significant difference between the two means (P = 0.250) suggesting two conclusions. The first is that the mean coefficients for both classes of tests which were locally generated are not significantly different at a critical value of 4.60 and an F score of 1.437. The second conclusion is that although the coefficient is below a 0.7, the pretest/posttests cannot be ruled out as a meaningless. It is well known that the shorter the test, the lower the coefficient (Hersen, Hilsenroth, & Segal, 2004, p. 7). The criminal justice test had 50 questions and the meteorology test had 48 questions. The low number of questions may mean that the reliability of the tests is not as optimal as researchers would like and that the variance across the tests is only 60% consistent. Additionally, it was found that the lower the number of participants taking the test, the lower the coefficient (Craighead & Nemeroff, 2001, p. 806). According to Gliem and Gliem (2003), a coefficient of less than 0.6 is poor to unacceptable (p. 87).

Data Used in Study

Accomodator. The challenge of this dissertation was to compare group work accommodator and diverger mean improvement scores to the class mean improvement score. The second challenge was to compare the accommodator and diverger mean improvement scores of the experimental group to the control group. The classes for the fall semester of 2008 were established as the control group. The classes for the spring semester of 2009 were established as the experimental group. Two types of classes were used. The first was the traditional bricks and mortar classes and the second type was the online classes. Since there were so few students who agreed to participate in the online

portion of the study from the criminal justice courses, they were not included in the study. If the null hypothesis is correct, then the group work accomplished by the experimental groups should reflect equal or higher improvement scores than the control groups (see Table 8).

Table 8

Matrix Identifying the Class and Category of Comparison

Category	Class	Category
Control Group	WXBMFA08	Accommodator vs. Improvement
		Diverger vs. Improvement
	WXOLFA08	Accommodator vs. Improvement
		Diverger vs. Improvement
Experimental Group	WXBMSP09	Accommodator vs. Improvement
		Diverger vs. Improvement
	WXOLSP09	Accommodator vs. Improvement
		Diverger vs. Improvement

Control Group—WXBMFA08. The first group considered was the bricks and mortar class in the fall of 2008. The descriptive statistics for that class can be seen in Table 9.

Table 9

Descriptive Statistics for WXBMFA08 Control Group

Activity	Size	Missing	Mean	Std Dev	Std Error	CI of Mean
Pretest	33	0	21.061	4.007	0.698	1.421
Posttest	33	0	29.273	7.694	1.339	2.728
Improvement	33	0	8.212	6.183	1.076	2.193

A one way ANOVA test was conducted to compare the mean improvement scores of the four LSI categories for the WXBMFA08 class, control group, against each other to see if a relationship existed among them. The calculated means for each category are represented in Figure 7. In the test, the claim of the null hypothesis was that no difference existed among the means (H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$). At a critical value of 2.93 and an F score 0.293, the decision was to not reject the null hypothesis (Table 10), and conclude that not enough evidence existed to reject the claim. Therefore, no significant statistical difference among the means could be found. Not one of the mean improvement scores for the LSI categories stood out from the rest for the WXBMFA08 class.

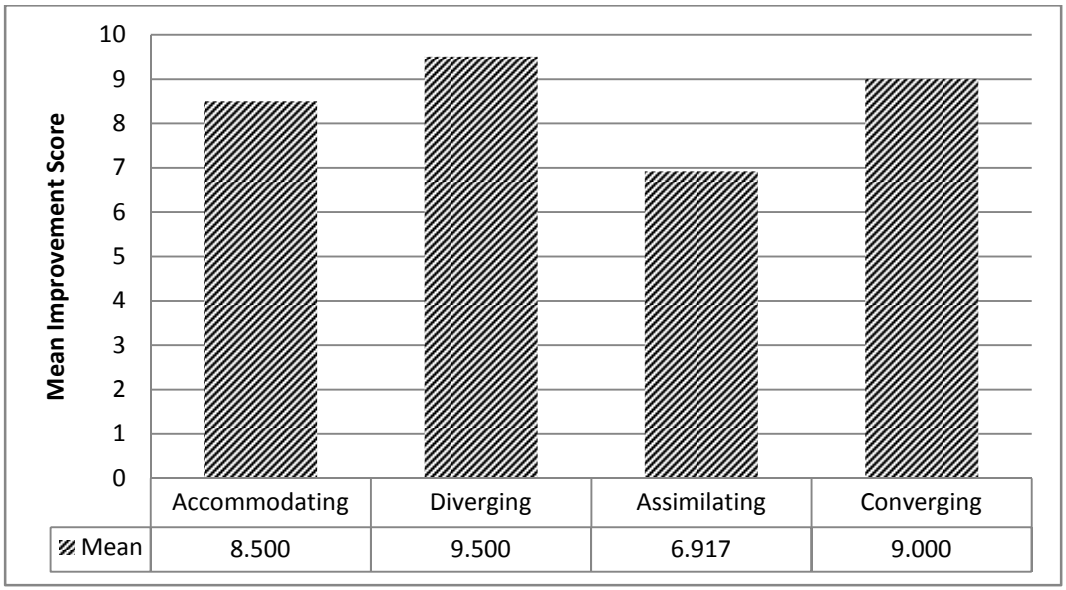


Figure 7. Mean Improvement Score for WXBMFA08 Control Group

Table 10

One Way ANOVA Test for WXBMFA08 Control Group Comparing LSI to Mean

Source	DF	SS	MS	F	P
Between Groups	3	36.098	12.033	0.294	0.829
Residual	29	1187.417	40.945		
Total	32	1223.515			

Note. Normality Test: Passed (P = 0.750); Equal Variance Test: Passed (P = 0.791).

Control Group—WXOLFA08. The second group looked at was the Online class in the fall of 2008. The descriptive statistics for that class are in Table 11, showing the mean and standard deviation for the pretest and post test as well as the average improvement score.

Table 11

Descriptive Statistics for WXOLFA08 Control Group

Activity	Size	Missing	Mean	Std Dev	Std Error	CI of Mean
Pretest	31	0	22.000	5.190	0.932	1.904
Posttest	31	0	29.484	6.082	1.092	2.231
Improvement	31	0	7.481	5.195	0.933	1.906

A one way ANOVA test was conducted to compare the mean improvement scores of the four LSI categories for the WXOLFA08 class, control group, against each other to see if a relationship existed among them. The calculated means for each category are represented in Figure 8. In the test, the claim of the null hypothesis was that no difference existed among the means (H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$). At a critical value of 2.96 and an F score 0.840, the decision was to not reject the null hypothesis (Table 12), and conclude that not enough evidence existed to reject the claim. Therefore, no significant statistical difference among the means could be found. Not one of the mean improvement scores for the LSI categories stood out from the rest for the WXOLFA08 class

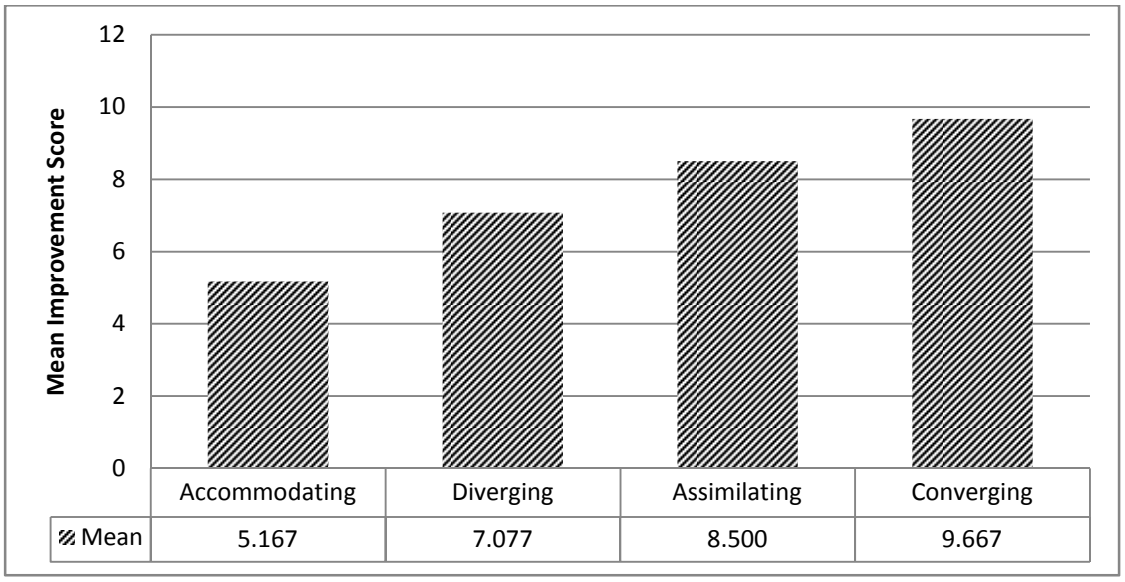


Figure 8. One Way ANOVA Test for WXOLFA08 control group comparing LSI to Mean.

Table 12

One Way ANOVA Test for WXOLFA08 Control Group Comparing LSI to Mean

Source	DF	SS	MS	F	P
Between Groups	3	69.152	23.051	0.840	0.484
Residual	27	740.590	27.429		
Total	30	809.742			

Note. Normality test passed (p = 0.548); Equal Variance Test passed (0.706).

Experimental Group—WXBMSP09. The third group examined was the Bricks and Mortar class in the fall of 2008. The descriptive statistics for that class can be seen in Table 13.

Table 13

Descriptive Statistics for WXBMSP09 Experimental Group

Activity	Size	Missing	Mean	Std Dev	Std Error	CI of Mean
Pretest	31	0	21.452	4.226	0.759	1.550
Posttest	31	0	29.839	5.860	1.052	2.149
Improvement	31	0	8.837	4.558	0.819	1.672

A one way ANOVA test was conducted to compare the mean improvement scores of the four LSI categories for the WXBMSP09 class, experimental group, against each other to see if a relationship existed among them. The calculated means for each category are represented in Figure 9. In the test, the claim of the null hypothesis was that no difference existed among the means (H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$). At a critical value of 2.98 and an F score 1.349, the decision was to not reject the null hypothesis (see Table 14), and conclude that not enough evidence existed to reject the claim. Therefore, no significant statistical difference among the means could be found. Not one of the mean improvement scores for the LSI categories stood out from the rest for the WXBMSP09 class.

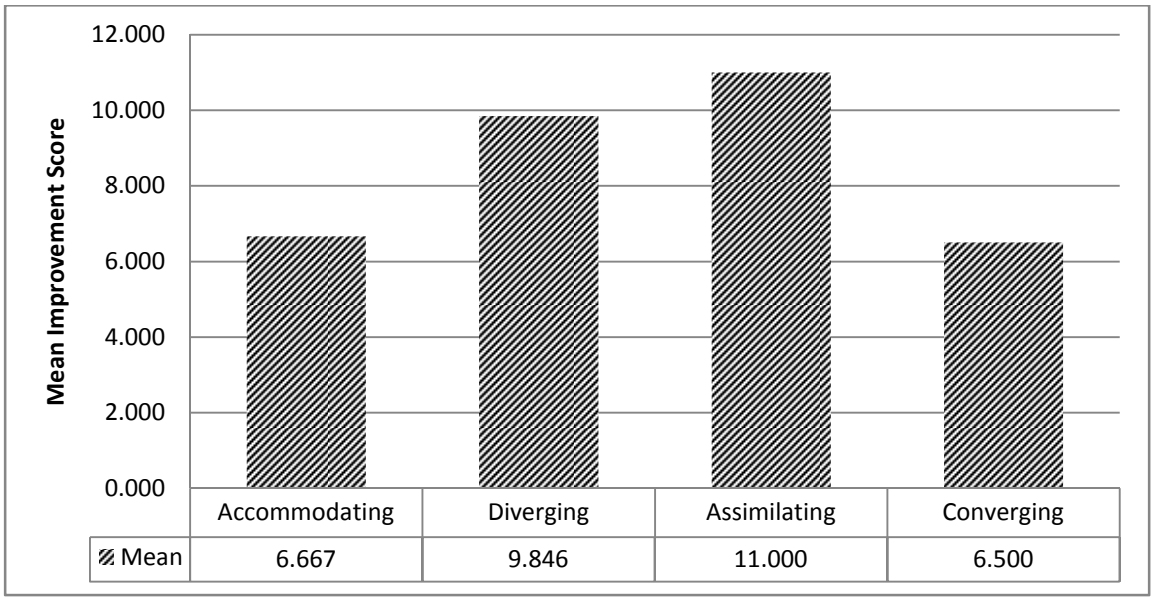


Figure 9. One Way ANOVA Test for WXBMSP09 control group comparing LSI category mean improvement scores.

Table 14

One Way ANOVA Test for WXBMSP09 Experimental Group Comparing LSI to Mean

Source	DF	SS	MS	F	P
Between Groups	3	74.174	24.725	1.349	0.280
Residual	26	476.492	18.327		
Total	29	550.667			

Note. Normality Test Passed (P = 0.574); Equal Variance Test Passed (P = 0.568).

Experimental Group—WXOLSP09. The fourth group looked at was the Online class, spring of 2009. The descriptive statistics for that class can be seen in Table 15.

Table 15

Descriptive Statistics for WXOLSP09 Experimental Group

Activity	Size	Missing	Mean	Std Dev	Std Error	CI of Mean
Pretest	31	0	22.065	5.674	1.019	2.081
Posttest	31	0	28.452	6.158	1.106	2.259
Improvement	31	0	6.387	6.489	1.166	2.380

A one way ANOVA test was conducted to compare the mean improvement scores of the four LSI categories for the WXOLSP09 class, experimental group, against each other to see if a relationship existed among them. The calculated means for each category are represented in Figure 10. In the test, the claim of the null hypothesis was that no difference existed among the means (H_0: $\mu_1 = \mu_2 = \mu_3 = \mu_4$). At a critical value of 2.96 and an F score 1.299, the decision was to not reject the null hypothesis (see Table 16), and conclude that not enough evidence existed to reject the claim. Therefore, no significant statistical difference among the means could be found. Not one of the mean improvement scores for the LSI categories stood out from the rest for the WXOLSP09 class.

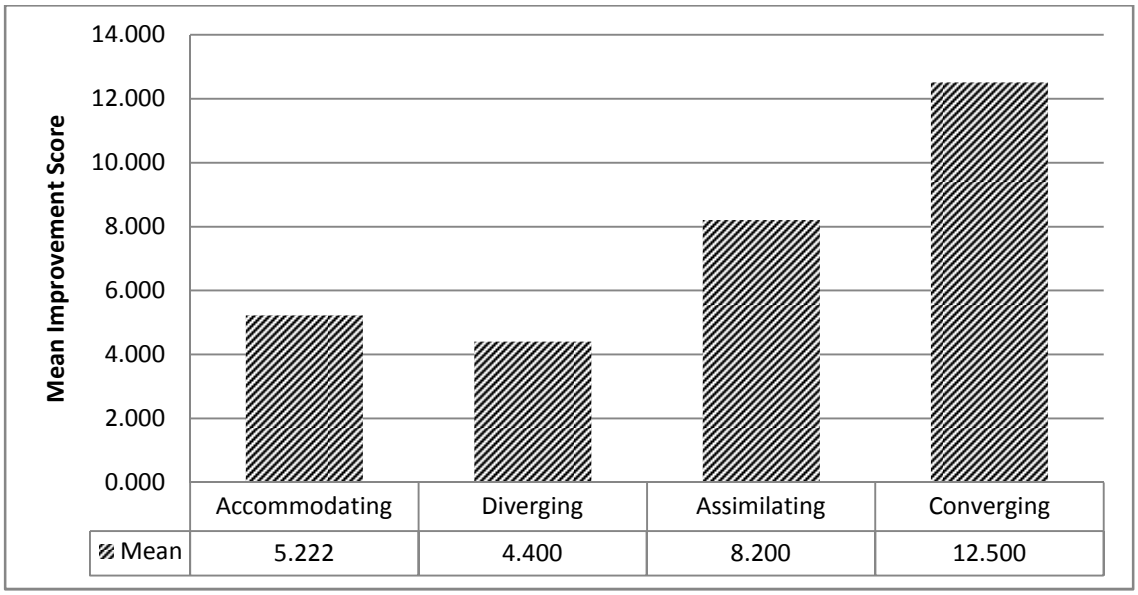


Figure 10. One Way ANOVA comparison of mean LSI improvement scores.

Table 16

ANOVA Test for WXOLSP09 Experimental Group Comparing LSI to Mean

Source	DF	SS	MS	F	P
Between Groups	3	159.299	53.100	1.299	0.295
Residual	27	1104.056	40.891		
Total	30	1263.355			

Note. Normality Test Passed (P = 0.058); Equal Variance Test Failed (P < 0.050).

Summary for accommodating learning style. The improvement mean for the classes taken from Tables 9, 11, 13, and 15 and the improvement mean for the accommodator category in each of the classes taken from Figures 7, 8, 9, and 10 were summarized in Table 17. A comparison of the means does not reflect any trend or pattern. The accommodator bricks and mortar students had a higher improvement mean than the

descriptive mean for the class. The accommodator online students had a lower improvement mean than the entire class. The online accommodator experimental group had a higher improvement mean than the online accommodator control group. The bricks and mortar accommodator experimental group had a lower improvement mean than the bricks and mortar control group. As an initial estimate, it would appear that the online classes benefitted more from the group work than the bricks and mortar classes.

Table 17

Comparison of Accommodator Experimental Group to Control Group

Category	Class	Descriptive Mean		Accommodator Mean		
		Mean	Std Dev	N =	Mean	Std Dev
Control Group	WXBMFA08	8.212	6.183	10	8.500	5.523
Control Group	WXOLFA08	7.484	5.195	6	5.160	5.269
Experimental Group	WXBMSP09	8.387	4.558	9	6.667	3.937
Experimental Group	WXOLSP09	6.387	6.489	9	5.222	2.949

The claim of the alternative hypothesis is that the accommodator experimental online class will have a significantly lower improvement score than the control group.

$$H_1: \mu < 5.160 \text{ and } H_o: \mu \geq 5.160$$

A t-test was run and the test score was calculated to be 0.063 with a P-value of 0.524. With $P_{0.54} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean accommodator online improvement score will be significantly lower than 5.160.

The claim of the alternative hypothesis is that the accommodator experimental bricks and mortar class will have a significantly lower improvement score than the control group.

$$H_1: \mu < 8.500 \text{ and } H_o: \mu \geq 8.500$$

A t-test was run and the test score was calculated to be -1.3967 with a P-value of 0.100. With $P_{0.10} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean accommodator bricks and mortar improvement score will be significantly lower than 8.500.

As a conclusion to the accommodator section, a research question was posed that asked if accommodator or diverger student performance scores were lower or higher than the rest of the class. It was found in this study that the online experimental group improvement mean was higher than the online control group. The accommodator bricks and mortar experimental group improvement mean was lower than the bricks and mortar control group improvement mean.

Diverger. Since the null hypothesis was rejected for the accommodator learning style, it is possible that a strong relationship exists between the diverger and the mean improvement score. The improvement mean for the classes taken from Tables 9, 11, 13, and 15 and the improvement mean for the diverger category in each of the classes taken from Figures 7, 8, 9, and 10 were summarized in Table 18. A comparison of the means does not reflect any trend or pattern. The diverger bricks and mortar students had a higher improvement mean than the descriptive mean for the class. The diverger online students had a lower improvement mean than the class. The online diverger experimental group

had a lower improvement mean than the online diverger control group. The bricks and mortar diverger experimental group had a higher improvement mean than the bricks and mortar control group.

Table 18

Comparison of Diverger Experimental Group to Control Group

Category	Class	Descriptive Mean			Diverger Mean	
		Mean	Std Dev	N =	Mean	Std Dev
Control Group	WXBMFA08	8.212	6.183	8	9.500	6.568
Control Group	WXOLFA08	7.484	5.195	13	7.077	4.112
Experimental Group	WXBMSP09	8.387	4.558	13	9.846	4.981
Experimental Group	WXOLSP09	6.387	6.489	10	4.400	9.857

Summary for the diverger learning style. As an initial estimate, it appears that the bricks and mortar classes benefitted more from the group work than the online classes. The claim of the alternative hypothesis is that the diverger experimental group will have a significantly lower improvement score than the control group for the online class.

$$H_1: \mu < 7.077 \text{ and } H_o: \mu \geq 7.077$$

A t-test was run and the test score was calculated to be -0.8588 with a P-value of 0.206. With $P_{0.206} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean diverger online improvement score will be significantly lower than 7.077.

The claim of the alternative hypothesis is that the diverger experimental group will have a significantly lower improvement score than the control group for the bricks and mortar class.

$$H_1: \mu < 9.500 \text{ and } H_o: \mu \geq 9.500$$

A t-test was run and the test score was calculated to be 0.2504 with a P-value of 0.596. With $P_{0.596} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean diverger bricks and mortar improvement score will be significantly lower than 9.500.

As a conclusion to the diverger section, a research question was posed that asked if accommodator or diverger student performance scores were lower or higher than the rest of the class. It was found in this study that the online experimental group improvement mean was lower than the online control group. The diverger bricks and mortar experimental group improvement mean was higher than the bricks and mortar control group improvement mean.

Assimilator. The null hypothesis for the diverger could not be rejected. Therefore, the evaluation was expanded to include the remaining learning styles. Next consider the assimilator learning style. Table 19 was constructed using the information from Tables 9 through 16 and Figures 7 through 10.

Table 19

Comparison of Assimilator Experimental Group to Control Group

Category	Class	Descriptive Mean		Assimilator Mean		
		Mean	Std Dev	N =	Mean	Std Dev
Control Group	WXBMFA08	8.212	6.183	12	6.917	7.366
Control Group	WXOLFA08	7.484	5.195	6	8.500	7.423
Experimental Group	WXBMSP09	8.387	4.558	3	11.000	1.000
Experimental Group	WXOLSP09	6.387	6.489	10	8.200	4.050

The assimilator improvement mean was higher than the class improvement mean in all cases with the exception of the fall 2008 bricks and mortar class. The online assimilator improvement mean for the experimental group was lower than that for the control group. Additionally, the bricks and mortar experimental group improvement mean was higher than that of the control group.

Summary for assimilator learning style. The claim of the alternative hypothesis is that the assimilator experimental group will have a significantly lower improvement score than the control group for the online class.

$$H_1: \mu < 8.500 \text{ and } H_o: \mu \geq 8.500$$

A t-test was run and the test score was calculated to be -0.234 with a P-value of 0.410. With $P_{0.410} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean assimilator online improvement score will be significantly lower than 8.500.

The claim of the alternative hypothesis is that the assimilator experimental group will have a significantly lower improvement score than the control group for the bricks and mortar class.

$$H_1: \mu < 6.917 \text{ and } H_o: \mu \geq 6.917$$

A t-test was run and the test score was calculated to be 7.071 with a P-value of 0.990. With $P_{0.99} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean assimilator online improvement score will be significantly lower than 6.917.

As a conclusion to the assimilator section, a research question was posed that asked if assimilator or converger student performance scores were lower or higher than the rest of the class. It was found in this study that the online experimental group improvement mean was lower than the online control group. The assimilator bricks and mortar experimental group improvement mean was higher than the bricks and mortar control group improvement mean.

Converger. Since the null hypothesis relative to the assimilator could not be rejected, the final learning style was evaluated. Next consider the converger learning style. The Table 20 was constructed using the information from Tables 9 through 16 and Figures 7 through 10.

Table 20

Comparison of Converger Experimental Group to Control Group

Category	Class	Descriptive Mean			Converger Mean	
		Mean	Std Dev	N =	Mean	Std Dev
Control Group	WXBMFA08	8.212	6.183	3	9.000	2.646
Control Group	WXOLFA08	7.484	5.195	6	9.667	4.967
Experimental Group	WXBMSP09	8.387	4.558	6	6.500	4.550
Experimental Group	WXOLSP09	6.387	6.489	2	12.500	3.536

From the comparison of the improvement means for the classes and the converger improvement mean it was found that the converger improvement mean was higher than the class improvement mean for all classes except for the spring 2009 bricks and mortar class. The online experimental group converger improvement mean was higher than the online control group improvement mean. However, the bricks and mortar experimental group converger improvement mean was lower than that of the control group.

Summary for converger learning style. The claim of the alternative hypothesis is that the converger experimental group will have a significantly lower improvement score than the control group for the online class.

$$H_1: \mu < 9.667 \text{ and } H_o: \mu \geq 9.667$$

A t-test was run and the test score was calculated to be 1.133 with a P-value of 0.7690 With $P_{0.769} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not

enough evidence to support the claim that the mean assimilator online improvement score will be significantly lower than 9.667.

The claim of the alternative hypothesis is that the converger experimental group will have a significantly lower improvement score than the control group for the bricks and mortar class.

$$H_1: \mu < 9.000 \text{ and } H_o: \mu \geq 9.000$$

A t-test was run and the test score was calculated to be -1.345 with a P-value of 0.118 With $P_{0.118} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean assimilator online improvement score will be significantly lower than 9.000.

As a conclusion to the converger section, a research question was posed that asked if assimilator or converger student performance scores were lower or higher than the rest of the class. It was found in this study that the online experimental group improvement mean was higher than the online control group. The converger bricks and mortar experimental group improvement mean was lower than the bricks and mortar control group improvement mean.

Effectiveness of Group Work. In all four categories of learning style, the null hypothesis could not be rejected for either the online class or the bricks and mortar class. Essentially the use of group work to raise posttest scores over pretest scores based on learning style was not proven to be consistently effective. Table 21 is a summary of the effect of group work on the classes arranged by learning style.

Table 21

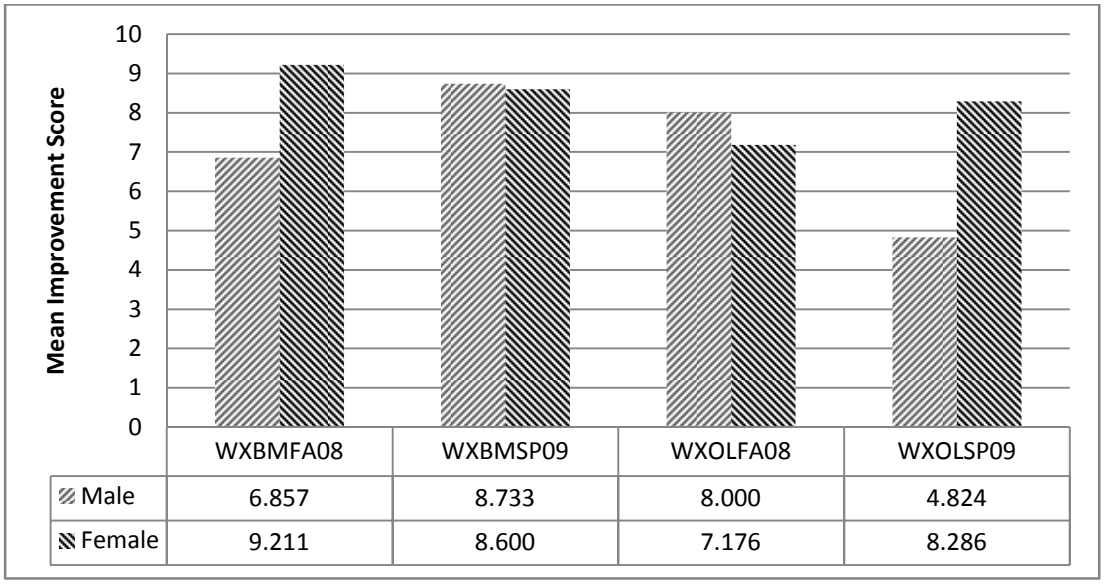
Effect of Group Work Based on Learning Style

LSI	Class	Did group work help? Based on mean score
Accommodator	Bricks and Mortar	No
	Online	Possibly
Diverger	Bricks and Mortar	Possibly
	Online	No
Assimilator	Bricks and Mortar	Possibly
	Online	No
Converger	Bricks and Mortar	No
	Online	Possibly

Group work appears to have had a positive effect on the improvement scores for the diverger and assimilator bricks and mortar classes and with the converger and accommodator online classes. The t-test did not reject the null hypothesis indicating that there was no change in improvement or possibly an improvement in all cases. At this stage of this research project, any conclusions should address the small sample size in each category. It cannot be said conclusively that group work is essential to either the accommodator or diverger learning styles. Additionally it cannot be said at this stage that the accommodator or diverger learner should not take an online course. Hence this answers the research question relative to the impact group work offered in each experimental group class on the performance scores.

Other Descriptive Categories

Gender. Another aspect considered was the gender of the students relative to improvement on the pretest/posttest. The female students' analyses were considered first, followed by the males' analysis. A One Way ANOVA test was run comparing gender to improvement. The mean improvement scores for both the males and females are displayed in Figure 11. The ANOVA comparisons of the means are displayed in Tables 22, 23, 24, and 25.



	WXBMFA08	WXBMSP09	WXOLFA08	WXOLSP09
Male	6.857	8.733	8.000	4.824
Female	9.211	8.600	7.176	8.286

Figure 11. Comparison of gender to mean improvement score by class.

Table 22

One Way ANOVA Comparison of Gender to Mean Improvement for WXBMFA08 Class

Source	DF	SS	MS	F	P
Between Groups	1	4.643	44.643	1.174	0.287
Residual	31	1178.872	38.028		
Total	32	1223.515			

Note. Normality Test Passed (P = 0.768); Equal Variance Test Passed (P = 0.303).

At a critical value of 4.17 and an F score of 0.287, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by gender. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXBMFA08 class.

Table 23

One Way ANOVA Comparison of Gender to Mean Improvement for WXBMSP09 Class

Source	DF	SS	MS	F	P
Between Groups	1	0.133	0.133	0.00678	0.935
Residual	28	550.533	19.662		
Total	29	550.667			

Note Normality Test Passed (P = 0.471); Equal Variance Test Passed (P = 0.391).

At a critical value of 4.20 and an F score of 0.00678, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean

improvement score by gender. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXBMSP09 class.

Table 24

One Way ANOVA Comparison of Gender to Mean Improvement for WXOLFA08 Class

Source	DF	SS	MS	F	P
Between Groups	1	810.471	5.404	0.200	0.658
Residual	30	810.471	27.016		
Total	31	815.875			

Note. Normality Test Passed (P = 0.377); Equal Variance Test Passed (P = 0.902).

At a critical value of 4.17 and an F score of 0.200, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by gender. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXOLFA08 class.

Table 25

One Way ANOVA Comparison of Gender to Mean Improvement for WXOLSP09 Class

Source	DF	SS	MS	F	P
Between Groups	1	92.027	92.027	2.278	0.142
Residual	29	1171.328	40.391		
Total	30	1263.355			

Note. Normality Test Passed (P = 0.276); Equal Variance Test Passed (P = 0.761).

At a critical value of 4.18 and an F score of 2.278, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by gender. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXOLSP09 class.

The results of comparing the class improvement mean to the female improvement mean are shown in Table 26.

Table 26

Comparison of Female Mean Improvement to the Class Mean

Category	Class	Descriptive Mean			Female Mean	
		Mean	Std Dev	N =	Mean	Std Dev
Control Group	WXBMFA08	8.212	6.183	19	9.211	5.006
Control Group	WXOLFA08	7.484	5.195	17	8.000	5.732
Experimental Group	WXBMSP09	8.387	4.558	15	8.733	4.636
Experimental Group	WXOLSP09	6.387	6.489	14	8.286	6.866

In all cases, the female improvement mean score surpassed the overall improvement mean for each of the classes. The female mean improvement score for the online experimental group was higher than the improvement mean for the control group.

The female improvement mean score for the bricks and mortar class was lower than the improvement mean for the control group.

The claim in the alternative hypothesis is that the female experimental group will have a significantly lower improvement score than the control group for the online class.

$$H_1: \mu < 8.000 \text{ and } H_o: \mu \geq 8.000$$

A t-test was run and the test score was calculated to be 0.156 with a P-value of 0.561 With $P_{0.561} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean female online improvement score will be significantly lower than 8.000.

The claim in the alternative hypothesis is that the female experimental group will have a significantly lower improvement score than the control group for the bricks and mortar class.

$$H_1: \mu < 9.211 \text{ and } H_o: \mu \geq 9.211$$

A t-test was run and the test score was calculated to be 0.399 with a P-value of 0.348. With $P_{0.348} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean female bricks and mortar improvement score will be significantly lower than 9.211.

Turning now to the males, the data consolidated from Tables 22 thru 25 are shown in Table 27.

Table 27

Comparison of Male Mean Improvement to the Class Mean

Category	Class	Descriptive Mean			Male Mean	
		Mean	Std Dev	N =	Mean	Std Dev
Control Group	WXBMFA08	8.212	6.183	14	6.857	7.482
Control Group	WXOLFA08	7.484	5.195	17	7.176	4.680
Experimental Group	WXBMSP09	8.387	4.558	15	8.600	4.222
Experimental Group	WXOLSP09	6.387	6.489	17	4.824	5.908

The male improvement mean exceeded the class improvement mean in only one class, the bricks and mortar experimental group. In the other three cases, the male improvement mean was lower. The male improvement mean for the online experimental group was higher than the improvement mean for the control group. However, the male improvement mean for the bricks and mortar experimental group was lower than that of the improvement mean for the control group.

The claim of the alternative hypothesis is that the male experimental group will have a significantly lower improvement score than the control group for the online class.

$$H_1: \mu < 7.176 \text{ and } H_o: \mu \geq 7.176$$

A t-test was run and the test score was calculated to be -1.641 with a P-value of 0.060 With $P_{0.060} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean male online improvement score will be significantly lower than 7.176.

The claim of the alternative hypothesis is that the male experimental group will have a significantly lower improvement score than the control group for the bricks and mortar class.

$$H_1: \mu < 6.857 \text{ and } H_o: \mu \geq 6.857$$

A t-test was run and the test score was calculated to be 1.599 with a P-value of 0.934. With $P_{0.934} > \alpha_{0.05}$, the null hypothesis was not rejected. The conclusion is that there is not enough evidence to support the claim that the mean male online improvement score will be significantly lower than 6.857.

Summary for gender. Both genders had mixed results. The experimental group mean improvement score for females was lower for the online class but higher for the bricks and mortar class. The experimental group mean improvement score for males was lower for the online class but higher for the bricks and mortar class. The null hypothesis for both male and female online and bricks and mortar classes was not rejected indicating that it was possible that the group work either kept the improvement score the same or raised it. The alternative hypothesis claim was not validated. Essentially, the use of group work to raise posttest scores over pretest scores based on gender was not consistently effective. Table 28 is a summary of the effect of group work on the classes arranged by gender.

Table 28

Effect of Group work based on Gender

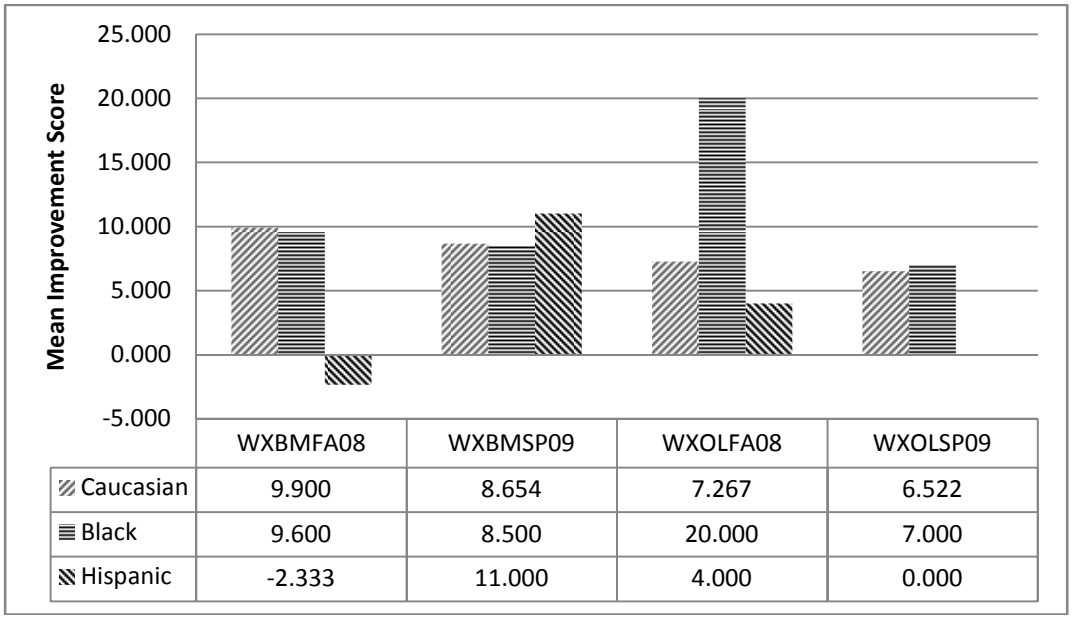
Gender	Class	Did group work help?
Female	Bricks and Mortar	No
	Online	Possibly
Male	Bricks and Mortar	Possibly
	Online	No

There does not seem to be any discernable general pattern for a relationship between gender and group work as an aid to increasing improvement scores. What is noticeable is that female students did significantly better in two of the four meteorology classes than the male students.

As a conclusion to the gender section, a research question was posed that asked if higher or lower performance scores were attributed to other factors such as age, gender, or ethnicity. It was found in this study that the female online experimental group improvement mean was higher than the online control group. The female bricks and mortar experimental group improvement mean was lower than the bricks and mortar control group improvement mean. The male online experimental group improvement mean was lower than the online control group. The male bricks and mortar experimental group improvement mean was higher than the bricks and mortar control group improvement mean.

Ethnicity versus improvement. Since there were no statistically significant findings relative to learning style or gender, the next area to be considered was the

relationship between ethnicity and improvement. One Way ANOVA tests were run on three of the four classes, and the data are presented in Tables 29, 30, and 32. A descriptive statistic was run on one class instead of ANOVA as there were not enough students in the Black or Hispanic categories to calculate a true mean. The results of that test are presented in Table 31.



	WXBMFA08	WXBMSP09	WXOLFA08	WXOLSP09
Caucasian	9.900	8.654	7.267	6.522
Black	9.600	8.500	20.000	7.000
Hispanic	-2.333	11.000	4.000	0.000

Figure 12. Mean improvement score by ethnicity for each class.

Table 29

One Way ANOVA Test of Ethnicity vs. Mean Improvement Score for WXBMFA08 Class

Source	DF	SS	MS	F	P
Between Groups	4	503.348	125.837	4.893	0.004
Residual	28	720.167	25.720		
Total	32	1223.515			

Note. Normality Test Passed (P = 0.757); Equal Variance Test Passed (P = 0.551).

At a critical value of 2.71 and an F score of 4.893, the decision to reject the null hypothesis led to the conclusion that there was enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by ethnicity. Therefore, a statistically significant relationship was revealed by the ANOVA test for the WXBMFA08 class.

Table 30

One Way ANOVA Test of Ethnicity vs. Mean Improvement Score for WXBMSP09

Source	DF	SS	MS	F	P
Between Groups	1	0.440	0.440	0.00211	0.964
Residual	26	542.385	20.861		
Total	27	542.429			

Note. Normality Test Passed (P = 0.798); Equal Variance Test Passed (P = 0.182).

At a critical value of 4.23 and an F score of 0.00211, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by ethnicity. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXBMSP09 class.

Table 31

Ethnicity versus Mean Improvement for WXOLFA08

Ethnicity	N =	Missing	Mean	Std Dev	SEM
Caucasian	30	0	7.267	4.719	0.862
Black	1	0	20.000	0.000	0.000
Hispanic	1	0	4.000	0.000	0.000

Note. A Normality test or Equal Variance Test could not be established because of the lack of participants in the Black and Hispanic categories.

Table 32

One Way ANOVA Test of Ethnicity versus Mean Improvement for WXOLSP09 Class

Source	DF	SS	MS	F	P
Between Groups	1	0.779	0.779	0.0166	0.899
Residual	25	1175.739			
Total	26	1176.519			

Note. Normality Test Failed ($P < 0.050$); Equal Variance Test Passed ($P = 0.622$).

At a critical value of 4.24 and an F score of 0.0166, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by ethnicity. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXOLSP09 class.

Summary for ethnicity. It has been established that in two of the four classes, no significant relationship existed between ethnicity and the improvement mean. Using data from just mean values a comparison between the classes was conducted to see if there was a trend indicated between the experimental group and the control group. The results of the comparison are presented in Table 33.

Table 33

Comparison of Ethnicity to Mean Improvement Score

	WXBMFA08 Control Group		WXBMSP09 Experimental Group		WXOLFA08 Control Group		WXOLSP09 Experimental Group	
	N =	Mean	N =	Mean	N =	Mean	N =	Mean
Caucasian	20	9.900	26	8.654	30	7.267	23	6.522
Black	3	3.000	2	8.500	1	20.000	4	7.000
Hispanic	3	-2.333	1	11.000	1	4.000	0	—

The data revealed a mixed conclusion. When comparing the experimental group to the control group, the improvement score was found to be lower in all cases except the Black and Hispanic bricks and mortar classes. The results of Table 33 address the research question that asked if higher or lower performance scores were attributed to other factors such as age, gender, or ethnicity.

Table 34 is a summary of the possible help that group work might have had based on ethnicity. When comparing the experimental group improvement mean to the control

group improvement mean for the bricks and mortar class, it appears that there might be a positive trend. One possible explanation is that the group work might have overcome a language barrier with the Hispanic students. However, the number of participants was so low, such a conclusion would have to be limited.

Table 34

Effect of Group Work Based on Ethnicity

Gender	Class	Did group work help?
Caucasian	Bricks and Mortar	No
	Online	No
Black	Bricks and Mortar	Possibly
	Online	No
Hispanic	Bricks and Mortar	Possibly
	Online	—

Year versus improvement. One Way ANOVA test was conducted comparing the student's year in the university—freshman, sophomore, junior, and senior—with his or her mean improvement score (Figure 13).

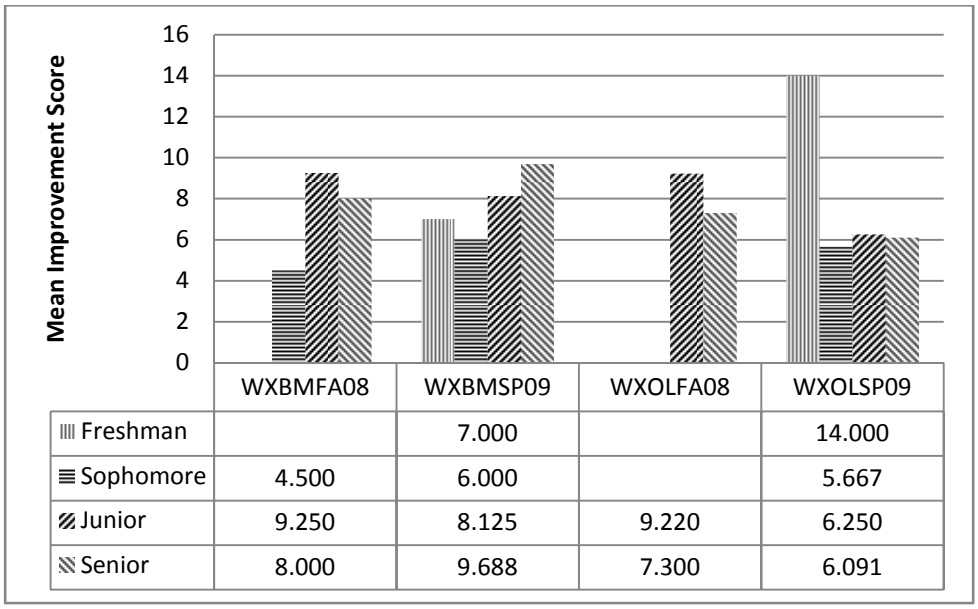


Figure 13. Mean improvement score by year.

Table 35

One Way ANOVA Comparison of Year in College to Mean Improvement Score for WXBMFA08

Source	DF	SS	MS	F	P
Between Groups	2	41.250	20.625	0.507	0.608
Residual	29	1180.750	40.716		
Total	31	1222.00			

Note. Normality Test Passed (P = 0.249); Equal Variance Test Passed (P = 0.762).

At a critical value of 3.33 and an F score of 0.507, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by year in school. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXBMFA08 class.

Table 36

One Way ANOVA Comparison of Year in College to Mean Improvement Score for WXBMSP09

Source	DF	SS	MS	F	P
Between Groups	2	40.281	20.140	1.032	0.371
Residual	26	507.512	19.250		
Total	28	547.793			

Note. Normality Test Passed (P = 0.458); Equal Variance Test Passed (P = 0.661).

At a critical value of 3.37 and an F score of 1.032, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by year in school. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXBMSP09 class.

Table 37

One Way ANOVA Comparison of Year in College to Mean Improvement Score for WXOLFA08

Source	DF	SS	MS	F	P
Between Groups	2	111.922	55.961	2.265	0.123
Residual	28	691.756	24.706		
Total	30	803.677			

Note. Normality Test Passed (P = 0.135); Equal Variance Test Passed (P = 0.142).

At a critical value of 3.34 and an F score of 2.265, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by year in school. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXOLFA08 class.

Table 38

One Way ANOVA Comparison of Year in College to Mean Improvement Score for WXOLSP09

Source	DF	SS	MS	F	P
Between Groups	2	0.891	0.445	0.0100	0.990
Residual	27	1202.576	44.540		
Total	29	1203.467			

Note. Normality Test Failed (P < 0.050); Equal Variance Test Passed (P = 0.199).

At a critical value of 3.35 and an F score of 0.0100, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by year in school. Therefore, no statistically significant relationship was revealed by the ANOVA test for the WXOLSP09 class.

The results did not indicate any consistent pattern where group work helped the student's improvement score answering the research question relative to the impact that other factors such as age, gender, or ethnicity had on the outcome. It is possible that

group work helped the bricks and mortar senior and sophomore classes. Group work does not appear to have benefitted the online junior or senior classes. There is a void in the data for the freshman and sophomore control group classes due to a lack of participants.

Bias. A major concern of this researcher was to ensure that a bias was not introduced into the project. The attempt was made to eliminate bias by collecting data from classes taught by two different professors; one from meteorology and one from criminal justice. There were not enough students in the criminal justice classes who agreed to be part of the sampling process, and the data from the criminal justice classes were eliminated. As a check against any bias, a One Way ANOVA test and a t-test were conducted to see if there was any statistically significant difference in the two classes (Table 39). At a critical value of 4.06 and an F score of 0.516, the decision to not reject the null hypothesis led to the conclusion that there was not enough evidence to reject the claim that no significant statistical difference could be found among the mean improvement score by bias. Therefore, no statistically significant relationship was revealed by the ANOVA test.

Table 39

One Way ANOVA Comparison of Criminal Justice Class to Meteorology Class for Bias

Source	DF	SS	MS	F	P
Between Groups	1	17.019	17.019	0.516	0.476
Residual	44	1451.699	32.993		
Total	45	1468.717			

Note. Normality Test Passed (P = 0.766); Equal Variance Test Passed (P = 0.665).

A t-test was conducted to compare the mean improvement scores for the Criminal justice class to the meteorology class. With a DF of 44 and an alpha of 0.05, a confidence interval was established of -5.427 to 2.575. Since P0.476 > α0.05, the null hypothesis claiming that the means were significantly different was not rejected, concluding that a significant difference in the mean improvement scores does not exist.

Table 40

t-Test Comparison of Criminal Justice Class to Meteorology Class for Bias

Class	N =	Missing	Mean	Std Dev	SEM
CJBMFA08	11	0	6.545	4.390	1.324
WXBMFA08	35	0	7.971	6.085	1.029

No statistically significant relationship revealed by the ANOVA test or the t-test, therefore, it can be reasonably concluded that there is no real bias based on data analyzed from just the meteorology class taught by one professor. This addresses the research question pertaining to any biases in the data or data collection process that might have a serious impact on the overall results of the study.

WebCT survey. Students in the online courses were asked to complete a survey at the end of the course to see if there were any problems using the WebCT platform (Attachment D). The survey consisted of ten questions. The students were asked to rate their reactions to the questions using a Likert Scale that ranged from 1, for Strongly Disagree, to a 5, for Strongly Agree. The number of responses for each category is listed in the Table 37 along with the average for each question.

Table 41

WXOLFA08 WebCT Survey

		Strongly Disagree				Strongly Agree	
	Question	1	2	3	4	5	Average
1	Using WebCT was frustrating	10	8	10	4	3	2.486
2	Learning to use WebCT was easy	1	3	5	14	12	3.943
3	If I encountered difficulties using WebCT, my professor or the Help Desk would walk me through the problem	0	2	10	10	13	3.971
4	Using WebCT was an effective way to learn the course content	4	2	13	13	3	3.257
5	I learned a great deal through the use of WebCT	0	8	14	10	3	3.229
6	WebCT made it easy for me to work with other students in the course	9	6	14	4	2	2.543
7	Group online activities did not improve the quality of my learning through this media	2	5	20	5	3	3.057
8	My learning style is not compatible with online learning	6	9	8	4	8	2.971
9	I will not voluntarily take another course using WebCT	9	8	10	5	3	2.571
10	Overall, my experience using WebCT was very successful	1	4	12	11	7	3.543

Note. Questions 1 through 7 are taken from Comparing dropouts and persistence in e-learning courses, by Yair Levy, 2004, Computers & Education, 48, p. 201. Copyright 2007 by Elsevier Ltd. Adapted with permission.

As a summary of this survey from the Fall 2008 online class, the control group, it should be noted that no group work was conducted with this class. As a group, the class felt comfortable using WebCT and had no difficulties learning how to use the software, or knowing where to go to get help. The interesting feature of this particular survey is the way the students are spread across the scale relative to their learning style (Question 7) and online learning (Question 5). This may provide insight into the reason no significant statistical relationships were found in improvement scores based on learning styles.

Table 42 is a summary of the experimental group use of WebCT. The responses along with the averages are listed.

Table 42

WXOLSP09 WebCT Survey

		Strongly Disagree				Strongly Agree	
	Question	1	2	3	4	5	Average
1	Using WebCT was frustrating	3	6	11	9	5	3.206
2	Learning to use WebCT was easy	1	8	3	12	10	3.647
3	If I encountered difficulties using WebCT, my professor or the Help Desk would walk me through the problem	0	1	15	10	8	3.735
4	Using WebCT was an effective way to learn the course content	6	8	10	7	3	2.794
5	I learned a great deal through the use of WebCT	5	7	10	10	2	2.912
6	WebCT made it easy for me to work with other students in the course	8	9	8	8	1	2.559
7	Group online activities did not improve the quality of my learning through this media	3	9	7	8	7	3.206
8	My learning style is not compatible with online learning	6	5	9	10	4	3.029
9	I will not voluntarily take another course using WebCT	6	6	8	4	10	3.176
10	Overall, my experience using WebCT was very successful	3	8	6	11	6	3.265

Note. Questions 1 through 7 are taken from Comparing dropouts and persistence in e-learning courses, by Yair Levy, 2004, Computers & Education, 48, p. 201. Copyright 2007 by Elsevier Ltd. Adapted with permission.

As with the control group, the experimental group felt that learning to use WebCT was easy. If they ran into problems, they knew where to go to get help. It is interesting that more students found using WebCT frustrating as opposed to not using it. More students did not feel that using WebCT was an effective way to learn. However, they felt they learned a lot by using WebCT. This seems to be a contradiction. The experimental groups' responses to the group work question are spread across the scale, the same as the control group who had no group work. Overall more students felt group work did help, and this may tie into the concept of group work related to learning style. While more students felt their learning style was compatible with online learning, they would not voluntarily take another course using WebCT. Overall they felt their experience was successful.

Qualitative phase of study. Prior to the start of the semester, the students who were in the online class were sent a letter notifying them that the course would be taught online. It was suggested that if they had any problems with this arrangement, they should consider transferring out of the class. In the fall of 2008, 42 students enrolled in the class. Seven of them dropped the class. Those who dropped the class were asked to give the reasons for not taking the course online. They were asked five questions. See the Attrition Survey in Attachment E. The intent of the questions was to see if the problem was personal, equipment related, or other concerns. Of the seven students, two responded to

the Attrition Survey. One student preferred face-to-face contact with the professor. The second student lacked the discipline to set priorities and follow through to complete the work online. Neither student had taken an online course before.

Prior to the start of the Spring 2009 semester, the students in the online class were notified that the class would be taught online. They were given a chance to transfer out of the course if they felt they could not handle course materials online. Forty-seven students had enrolled in the online course. Thirteen students dropped the course sometime during the semester. Three students responded to the Attrition Survey. Two students transferred to the bricks and mortar class preferring face-to-face contact with the professor. The third student lost the capability to use the Internet because the service provider was based in Texas and was shut down after a hurricane destroyed the facility. These three students had not taken an online class previously.

The reasons for dropping the class do not fit any consistent pattern or trend. Additionally, there was not enough data to allow for a significant conclusion. Therefore, the research question that addresses the reasons that students did not complete the course successfully due to technical limitations, personal issues, process issues, or course design issues cannot be answered by this study.

Summary

Without arriving at any conclusions, the data has provided the following information. Group work appears to raise the improvement mean for online students with an accommodator learning style, a converger learning style, and female students. Group work does not appear to raise the improvement mean for online students with a diverger

learning style, an assimilator learning style, male students, Caucasian students, Black students, junior students, and senior students. Group work appears to raise the improvement mean for bricks and mortar students with a diverger learning style, an assimilator learning style, male students, Black students, Hispanic students, sophomore students, and senior students. Group work does not appear to raise the improvement mean for bricks and mortar students with an accommodator learning style, a converger learning style, female students, Caucasian students, and junior students. The effect of group work could not be determined for both online and bricks and mortar freshman students.

These 23 items establish the basis for the conclusions that will be drawn in the next chapter. As part of that process, this study will tie into previous research. Recommendations for future studies will be included as well as suggestions for educators.

Chapter Five—Discussion, Conclusions, and Recommendations

Introduction

In the final chapter of this dissertation, a brief review of the previous four chapters will be presented. This will provide a capsule summary of what this dissertation attempted to accomplish and the processes necessary to obtain results. Then the remainder of this chapter will be devoted to a discussion of the results leading to some conclusions along with suggestions for future research and recommendations for this university and other online course designers.

Statement of the Problem

At the start of the dissertation, a claim was made through the alternative hypothesis that students who are categorized as social learners would have a lower improvement score in the class. A relationship was sought between learning style, performance in the class, and the quality of the online course. It was hypothesized that if a course designer strives to develop an online course that followed the rules for a high quality course as identified in Chapter One, the learning style of the student must be considered. Many learning style inventories were considered as part of this study. The list was narrowed down to the Kolb learning style inventory as identified in Chapter 2. The socialization process, a Kolb way of learning, was selected for study because it involved group work, discussions, and brainstorming. In particular the accommodator and diverger learners preferred the socialization process for learning. This way of learning was supported by Schaller, Borun, and Allison-Bunnell (2007) who identified as the

accommodating learning style preferring socialization (p. 8). Larkin and Budny (2005) felt that both the accommodator and diverger learner preferred group work (p. F4D-5). This researcher proposed the idea that if the social learner did well in online group projects, that is if their improvement score was higher than the control group, then it would be apparent that learning style was a necessary component of a quality online course.

Review of the Methodology

In the fall of 2008, four classes were selected to be used in this experiment; two bricks and mortar classes and two online classes. In each category there was one meteorology class and one criminal justice class. A pretest was administered at the start of the semester and a posttest at the end of the semester with the difference between these two test scores representing the student improvement or lack thereof. The four Fall 2008 classes were identified as the control groups to establish a baseline for the study.

In the Spring of 2009, four classes were selected to be used in the study; two bricks and mortar classes and two online classes. In each category there was one meteorology class and one criminal justice class. A pretest was administered at the start of the semester and a posttest at the end of the semester. During the semester, each class was assigned two group projects (the independent variable). The four Spring 2009 classes were identified as the experimental groups.

The analysis process was designed to compare the experimental groups results to the control groups results. The experimental bricks and mortar classes were compared to the control bricks and mortar classes. The experimental online classes were compared to

the control online classes. The accommodator learning style was evaluated first, followed by the diverger, assimilator, and converger.

Summary of Results

ANOVA results showed no significant differences; no trend or pattern could be discerned when comparing learning style to mean improvement score. When the categorical variables of gender, ethnicity, and class rank were introduced into the study, no statistically significant relationship was identified. In a comparison of the male improvement mean to the female improvement mean, females scored higher. No statistically significant relationship could be identified when ethnicity was related to improvement mean. Although there were a variety of ethnicities in the class, the analysis was limited to Caucasians, Blacks, and Hispanics. Finally, no statistically significant relationship could be identified when year in college was compared to improvement mean. When a t-test was run on each of the variables, the conclusion was to not reject the null hypothesis because there was not enough evidence to support the claim of the alternative hypothesis of lower improvement scores for the experimental groups. Thus the potential was there for the experimental group improvement scores to be the same as, or higher than the control group improvement scores.

Discussion of the Results

Interpretation of the findings. The data in Chapter Four are summarized in Table 43.

Table 43

Impact of Group Work on Variables

Group Work			
Online		Bricks and Mortar	
Improvement		Improvement	
Higher	Lower	Higher	Lower
-Accommodator -Converger	-Diverger -Assimilator	-Diverger -Assimilator	-Accommodator -Converger
-Female	-Male -Caucasian -Black -Junior -Senior	-Male -Black -Hispanic -Sophomore -Senior	-Female -Caucasian -Junior

The table is arranged to show the impact group work had on the online classes and the bricks and mortar classes. In each case, the experimental group was compared to the control group.

Group work appears to have helped the online accommodator and online converger. The accommodator is a social learner who thrives with group work. This substantiates the studies published by Schaller, Borun, and Allison-Bunnell (2007) and Larkin and Budny (2005). The online converger had a higher improvement score as well. This indicates that group work helped this learner even though that student was not a

social learner. Since the converger is said to prefer to work on projects alone, the results of this study would seem to contradict the social learner idea published in studies. The online diverger had a lower improvement mean indicating that group work did not aid this social learner. This also contradicts the concept of a social learner. The online assimilator had a lower improvement mean. This supports the idea that the assimilator is not a social learner and would prefer to work alone. Group work hindered these students' progress in the class.

The results of the bricks and mortar classes were opposite of those found in the online class. The accommodator had a lower improvement mean indicating that group work did not help this student who supposedly thrives on group work as part of the social learning process. The bricks and mortar converger also had a lower mean improvement score. This supports the idea of the converger not wanting to work in groups; that group work hinders this student's progress. The bricks and mortar diverger had a higher mean improvement score, which supports the social learning concept associated with group work. The bricks and mortar assimilator had a higher mean improvement score, which did not support the concept of this student preferring to work alone. Group work hindered this student's progress.

The question arises as to why such mixed results in this study. In searching for a possible answer, the improvement scores for just the two objectives involving group work were evaluated. The results are displayed in Table 44.

Table 44

Improvement Score for Group Objectives Only

Class	Objective 1 score	Objective 7/8 score
Experimental Group Online	-0.059	0.059
Control Group Online	-0.024	0.229
Improvement	-0.035	-0.170
Experimental Group Bricks and Mortar	0.071	0.199
Control Group Bricks and Mortar	0.052	0.115
Improvement	0.019	0.084

The mean was calculated for the experimental online course and the control online course and then compared. The online experimental group had a lower improvement score on both Objective 1 and Objective 7/8. This indicates that group work hindered the progress of the class in those two areas. Conversely for the bricks and mortar class, the experimental group had a higher improvement score than the control group indicating that group work helped raise the improvement score.

It appears that the socialization process did not function appropriately in the online class. At the start of the semester, the online class was told that there would be group work and to which group each student was assigned. The students were left to themselves to work out the details of the roles each group member would play in completing the assignment. The net result was that socialization did not take place. There are several possible reasons for this failure of socialization that might be explored in the future.

1. Students like to work at their own time schedule and not that of other students.
2. Students like to work at their own pace and not be tied down to others in a group.
3. Team leaders did not see team members face-to-face, but relied on e-mail for communication. If the student did not open his/her e-mail, the information from the team leader did not get transmitted.
4. There was not enough time for group dynamics to develop.

On the other hand, the bricks and mortar class had a higher improvement score for both Objectives 1 and 7/8. The socialization process appears to have worked in that class. It was observed in the classroom that team leaders talked to their team members, that team leaders made assignments, and that the members of each group collaborated with one another on those assignments. Team leaders were able to communicate face-to-face with team members and remind them of deadlines. Since they met face-to-face, the students were able to recognize each other at different locations on campus and collaborate at those times as necessary.

Considering gender, the online female student had a higher improvement mean indicating that group work helped to raise the score. The online male student had a lower improvement mean. When comparing the bricks and mortar classes, this was not true. The female students had a lower mean improvement and the males had a higher improvement score. The results of the ANOVA test indicated no statistically significant relationship exists between gender and improvement mean score. Therefore, there does not appear to be any pattern to explain the reason for such divergence.

The same mixed results were obtained when age in the class and ethnicity were considered. The ANOVA test results indicated that no statistically significant relationship existed between the variables and the mean improvement score. In the online classes, group work did not help raise the mean improvement score. In the majority of the bricks and mortar classes, group work did help raise the mean improvement score. No pattern exists to explain the reason for such divergence.

Since the results were mixed, it could be possible that the inconsistencies are due to the low number of participants in each of the variables. Although there were in excess of thirty students in each of the classes, this was not the case for each of the learning style variables. The participants ranged from a low of 2 to a high of 13. Such a low number might also make it difficult to obtain any statistically significant comparison. This was apparent with the ANOVA test conclusion.

A second possible reason for the inconsistency is that the group work did not comprise the entire content of the class. There were 13 objectives to be accomplished in the classes. Only two objectives were selected for group work in the study—structure of the atmosphere (Objective 1) and airmasses/fronts (Objective 7/8). Those two objectives were selected based on low Posttest scores on the objectives for the Fall 2008 classes. By conducting only two group projects, it was possible that the students would not have had enough time to get comfortable working together in groups and to work out any group dynamics problems. Additionally, any positive gains made in completing the group work for the two objectives may have been too small to have had a significant measurable affect on the total improvement score.

A third possible reason for the inconsistencies in the scores was that bias might have crept into the experiment. That bias might have been due to only one professor providing data for the study. That bias might have been injected into the treatment of the students, the grading, the preparation of the group work, the evaluation of the group work, or the teaching. Such a bias would be difficult to assess. The impact it would have on the improvement mean was even harder to assess.

Consequently, it was impossible to arrive at a data backed conclusion that the accommodator learning style supported by group work would improve a student's standing in a class. Based on this data, it was also impossible to identify those students who should not take online courses. Thus the claim of the alternative hypothesis, students who are categorized as social learners will have a lower improvement score in the class, was not substantiated.

Relationship of the Current Study to Previous Research

Schaller, Borun, and Allison-Bunnell (2007) identified the social learner as one with a preference for group work as seen in Chapter 2. This experiment supported the premise of Schaller, Borun, and Allison-Bunnell (2007) regarding the accommodating learning style in that group work appeared to help increase the mean improvement score. Larkin and Budny (2005) associated students who exhibited accommodating or diverging learning styles with group work. Accommodators like to engage in brainstorming sessions in groups. Divergers like discussion sessions. The data in this experiment supports the premise of Larkin and Budny (2005) for the accommodating learning style, but did not agree with them on the diverging learning style.

Recommendation for Educators

Although no significant conclusions could be drawn based on this experiment, educators should be very aware of the learning style of each student in their classes. By knowing the learning style, the educator can implement differentiated instruction in those areas where student achievement appears to be low. The question becomes one of which learning style system to use. Most educators are familiar with the Audio, Visual, Kinesthetic approach, but that may not be the appropriate one. The educator must conduct his or her own research and buy into a system that is appropriate for the age group and grade level of that class remembering that each class is different from year to year. That educator needs to be flexible.

Suggestions for Additional Research

It seems that whether the course is taught online or in the bricks and mortar, mode is not important. The results are not consistent throughout the change in variables. Since both the online courses and bricks and mortar courses could be reclassified as "hybrid" classes, the focus of the next research project should be done in that venue. The impact of group work should be studied in greater depth, concentrating on one mode of class, either online classes or bricks and mortar classes. Perhaps the group work should not cover just two objectives of the class, but all of the objectives. That way, any change in improvement should be more noticeable. Classes taught by other professors should be included in the study to eliminate any potential bias associated with a single professor. Involving other universities would also help eliminate the single professor bias. The

number of classes should cover several disciplines to eliminate professor bias. The sample size should be large enough so that each category has a minimum of 30 students assigned to it. In other words, there should be at least 30 accommodators, 30 divergers, 30 assimilators, and 30 convergers.

Conclusion.

The claim of the alternative hypothesis could not be supported. Therefore, the null hypothesis in this experiment was not rejected relative to the online classes. Students categorized as social learners with an accommodating learning style did not have a lower improvement score in the class. Group work did appear to increase the mean improvement score for online students; however, group work may not have been the causative factor. Improvement scores for the two objectives were lower for the experimental group than the control group.

The claim of the alternative hypothesis could not be supported for the bricks and mortar classes; therefore, the null hypothesis in this experiment was not rejected. Students categorized as social learners with a diverger learning style did have a higher improvement score in the class. Group work did help increase the mean improvement score for the bricks and mortar classes, and this was substantiated by the higher scores of the experimental group's two objectives over the control group.

The results were not consistent with the research in reference to the online converger and diverger learning styles as well as the bricks and mortar assimilator and accommodator learning styles. Therefore, to validate the null hypothesis, additional group work studies need to be accomplished using just one venue such as the bricks and

mortar classes. A recommendation for future research is to ensure all learning objectives be accomplished through group work. Enough data needs to be collected such that each learning style has at least 30 samples in it. Then, the data needs to be evaluated to validate the necessity for group work associated with specific learning styles.

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Appendix A

Participant Information and Consent Form

You are being asked to participate in a research project. Researchers are required to provide a consent form to inform you about the study, to convey that participation is voluntary, to explain risks and benefits of participation, and to enable you to make an informed decision. Please feel free to ask the researcher any questions you may have.

You are being asked to participate in a research study on online courses. Your participation in this study is important because you are an undergraduate student in an introductory college course. From this study, the researcher hopes to learn if there are any characteristics or personality traits that would indicate a student might have difficulty with an online class.

If you agree to be a part of this study, you will be asked to fill out a demographic questionnaire; complete a learning styles inventory, a pre-test; and a post-test. You have been asked to participate in this study because you are an undergraduate student in an introductory college course. From this study, the researcher hopes to learn whether or not learning styles, multiple intelligences, motivational indices, or personality traits have an impact on performance in an online course.

The potential benefits of this study may increase academic adviser's understanding of how a student might do in an online class based on certain personal characteristics. Your participation in this study will lead to the determination of those characteristics that indicate high or low academic performance. There are no risks associated with participation in this study.

The information for this study will be kept confidential, and data will be stored in a locked file cabinet.

Participation in this research project is completely voluntary. You have the right to say no. You also have the right to change your mind at any time and withdraw from the study. Choosing not to participate or withdrawing from this study will not affect your grade or evaluation in any way whatsoever.

There are no costs to you as a participant. Course credit will be assigned to your written work which will include exams, quizzes, and papers and to your participation in class discussions.

If you have any questions about this study please contact the researcher: Edward J Perantoni, Lindenwood University, 209 S. Kingshighway, St. Charles, MO 63301, 636-949-4705, eperantoni@lindenwood.edu

Your signature below means that you voluntary agree to participate in this research study.

_____ _____

Signature Date

You will be given a copy of this form to keep for your records.

Note. A large portion of this letter was based on the "Participant Information and Consent Form," created by Tonie Rincon-Guillardo, Associate Professor at Lindenwood University. It was an attachment to her *Application for IRB Review of Reserch Proposal Involving Human Subjects.* It was adapted for use in this study with her permission.

Appendix B

Demographic Questionnaire

Please complete the following information. Be sure to put your name on this form as matched pair data is needed. Your information is to be considered confidential and will be kept under lock and key.

1. Name:_____

2. Student Identification Number:_____

3. Female _____ Male _____

4. Age: _____

5. College Major _____

6. Current Year Status:

   Freshman ____ Sophomore ____ Junior ____ Senior _____

7. Ethnicity _____

Appendix C

CONDITIONAL USE AGREEMENT

For good and valuable consideration, the receipt and legal sufficiency of which are hereby acknowledged, I hereby agree that the permission granted to me by the Hay Group ("Hay")to receive and utilize, without charge, the Learning Style Inventory Version 3.1 ("LSI")is subject to the following conditions, all of which I hereby accept and acknowledge:

1. I will utilize the LSI for research purposes only and not for commercial gain.

2. The LSI, and all derivatives thereof, is and shall remain the exclusive property of Hay; Hay shall own all right, title and interest, including, without limitation, the copyright, in and to the LSI.

3. I will not modify or create works derivative of the LSI or permit others to do so. Furthermore, I understand that I am not permitted to reproduce the LSI for inclusion in my thesis/research publication.

4. I will provide Hay with a copy of any research findings arising out of my use of the LSI and will cite Hay in any of my publications relating thereto.

5. To translate the LSI, I need specific permission from Hay. If permission is granted, I will use the translation for my research only, and I am not permitted to include this translation in my thesis/research publication.

6. Hay will have no obligation to provide me with any scoring services for my use of the LSI other than the Algorithm used to score results.

7. Hay will not be deemed to have made any representation or warranty, express or implied, in connection with the LSI, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

8. My rights under this Agreement are non-transferable and non-exclusive and will be limited to a period of two (2) years from the date of this Agreement.

9. Hay may immediately terminate this Agreement by giving written notice to me in the event I breach any of this Agreement's terms or conditions.

10. This Agreement will be construed in accordance with the laws of Massachusetts without recourse to its conflict of laws principles.

11. This Agreement may not be assigned by me without the prior written consent of Hay.

12. Failure by Hay to enforce any provisions of this Agreement will not be deemed a waiver of such provision or any subsequent violation of the Agreement by me.

13. This is the entire agreement with Hay pertaining to my receipt and use of the LSI, and only a written amendment signed by an authorized representative of Hay can modify this Agreement.

Agreed and understood:

Signed	Edward J Perantoni	28 May 08
Signature	**Print Name**	**Date**

Note. This form was obtained from the Hay Group. As a prerequisite to receiving the Kolb LSI, the form had to be signed and returned to the Hay Group. The form was obtained from the following web site: http://www.haygroup.com/tl/downloads/LSI_Conditional_Use_Agreement.doc

Appendix D

End of Course Survey

This survey was adopted from Levy (2004).

Check the appropriate box. For example, if you strongly disagree, check box 1; if you strongly agree, check box 5.

		Strongly Disagree				Strongly Agree
	Question	1	2	3	4	5
1	Using WebCT was frustrating					
2	Learning to use WebCT was easy					
3	If I encountered difficulties using WebCT, my professor or the Help Desk would walk me through the problem					
4	Using WebCT was an effective way to learn the course content.					
5	I learned a great deal through the use of WebCT.					
6	WebCT made it easy for me to work with other students in the course					
7	Group online activities did not improve the quality of my learning through this media					
8	My learning style is not compatible with online learning.					
9	I will not voluntarily take another course using WebCT.					
10	Overall, my experience using WebCT was very successful.					

Note. Questions 1 through 7 are taken from Comparing dropouts and persistence in e-learning courses, by Yair Levy, 2004, Computers & Education, 48, p. 201. Copyright 2007 by Elsevier Ltd. Adapted with permission.

Appendix E

Attrition Survey

1. Why did you drop out of the online course?
2. Is this your first online course? If not, how many others have you been enrolled in?
3. Did you find the material too difficult to learn in the online environment?
4. Did you have the technology skills to be able to complete the course?
5. Did you have the equipment necessary to complete the course?

Appendix F

Curriculum Vitae

Edward J. Perantoni

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Lindenwood University
209 S. Kingshighway, St. Charles, MO 63301
636-949-4705; eperantoni@lindenwood.edu

BACKGROUND:

Completed fifteen years experience as faculty member at Lindenwood University developing curriculum for and teaching Earth Science courses. Three years experience as Director of Youth developing religious and fellowship programs for St. Mark Presbyterian Church. Two years as Program Manager, Special Projects, for an engineering program at the leading edge of technology and four years increasing experience in security at McDonnell Douglas. Twenty years of increasing experience in financial, personnel, and executive level management; administration; and training for the Air Weather Service (Meteorological Branch) of the Air Force. Attained the rank of Lieutenant Colonel while in the Air Force.

EDUCATION:

- MA in Physical Science, California State College, Chico CA 1970.
- BSBA in Accounting, University of Nebraska, Omaha NE 1984.
  Certificate in Meteorology, University of Oklahoma, Norman OK 1965.
- BS in Mathematics, Maryville College, Maryville TN 1964.

ACADEMIC AND PROFESSIONAL INTERESTS:

- Strong interest in the use of technology in the classroom, as a means to enhance the lecture mode.
- Strong interest in curriculum development for online courses. Currently administrator for the online platform WebCT.
- Completed forty-two semester hours of graduate level education course on a path toward a Doctorate.
- As a professional meteorologist, maintain contact with meteorological entities in the local community

PROFESSIONAL EXPOSURE:

- Director of Center for Computer Enhanced Learning and Technology, Lindenwood University: 1999-present.
    - Administrator for WebCT; create course shells, load coursework, load student lists, provide training to faculty.
- Associate Professor, 1999-present.
    - Earth Sciences, Lindenwood University.
    - Courses: Astronomy, Geology, Environmental Geology, Advanced Environmental Geology, Meteorology, Oceanography, Basic Statistics and College Algebra.
- Assistant Professor, 1994-1999.
    - Courses: Astronomy, Geology, Environmental Geology, Meteorology, Oceanography, College Algebra, Statistics.
- Director of Youth 1991-1994.
    - St. Mark Presbyterian Church.
    - Responsible for the development and implementation of Christian fellowship programs for youth and adults; responsible for the physical plant and site valued at over $4,000,000.00
- Instructor, 1980.
    - Sciences, Los Angeles Area Community College.
    - Courses: Meteorology, Physical Science
    - Taught courses; developed course curriculum and measurement evaluations for each course.
- Advanced Meteorologist, 1964-1985.
    - United States Air Force.
    - Radar meteorology instructor at Hill AFB; taught basic operation and interpretation principles; monitored operators' progress, prepared measurement evaluations, and conducted competency certifications for all weather forecasters.
    - Trainer for new workers in use of meteorological tools at the following Air Force installations: Chico Air Station CA, Qui Nhon – Vietnam, Williams AFB AZ, Hill AFB UT, Osan AFB – Republic of Korea, and Offutt AFB NE.
    - Member of Inspector General Team. Inspected weather stations worldwide for compliance to defined procedures; checked the competency of training programs for weather forecasters and weather observers.
- Other
    - Guest Astronomy instructor for grades 1 thru 5 at Rockwood School District.
    - Weather merit badge counselor for Boy Scouts.
    - Camp Director at Mound Ridge summer camp.
    - Instructor for Flight Ground School.
    - Instructor for Security Certification Classes.

PROFESSIONAL AFFILIATIONS:

- Member, American Meteorological Society since 1965.
- Member, St. Louis Chapter of American Meteorological Society since 1994.
- Chairman, Science Fair Committee, St. Louis Chapter of American Meteorological Society, 1996-1999.
- Certified Protection Professional, American Society for Industrial Security, 1988.
- Chairman, Education Committee, American Society for Industrial Security, 1989.
- Member, Villa Montessori Board of Directors, 1974.

SERVICE:

- Faculty Trainer, 1994-present
    - Train faculty members on various types of software including Windows 95, Windows 98, Netscape, Excel, PowerPoint.
    - Train faculty members, hands on, use of equipment in High Tech Classrooms; published tutorials for faculty on use of High Tech Classrooms.
    - Published tutorials for faculty on the use of WebCT, an online platform.
    - Chair of Computer Enhanced Learning Task Force, 1997 present; led task force in the study, procurement, and installation of multimedia equipment in classrooms; led in the procurement of WebCT as an intranet and online platform; led in the development of a distance learning policy for the university.

REFERENCES:

Available upon request.