HOW STUDENTS WITH DIFFERENT LEARNING STYLES COLLABORATE IN AN ONLINE LEARNING ENVIRONMENT

by

BO YANG

B.A., Southwest Normal University, China, 1996

M.S., Kansas State University, USA, 2001

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Secondary Education

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2007

ABSTRACT

This naturalistic case study was designed to provide descriptive data to examine the possible role of student learning styles in their collaborative participatory behaviors in an online text-based learning environment; and whether the technology-rich environment that promotes collaborative, project-based learning can have an effect on learners' participation behavior from the point of view of learning styles. In this study, graduate and advanced undergraduate students' discussion posts, project reports, reflections, and archived chat records were carefully analyzed. The research results indicated that, in an online collaborative learning environment participants were observed to use the Convergent, Divergent and Accommodating learning styles more often than Assimilating learning styles. Indeed, participants with the Assimilating learning style did not show a positive attitude towards online collaboration. Moreover, students who took a leadership role had their learning style kite shape close to the Concrete Experience learning mode; others who were more supportive had their kite shape close to the Reflective Observation "watching"; and those usually took both a leadership role and a supportive role and were comfortable with a variety of learning modes had their kite shape balanced along two or more dimensions of the learning cycles. The discussion of identified themes in this study is related to Kolb's Experiential Learning Theory framework. The study provides extended implications and suggestions for future research.

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ACKNOWLEDGEMENTS

This project would not have been possible without the support of many people. Many thanks to my advisor, Dr. Diane McGrath, who read my numerous revisions and helped make more sense of the complexity. Also thanks to my committee members, Dr. Chandima Cumaranatunge, Dr. Tweed Ross and Dr. John Staver, who offered guidance and support. Thanks to Dr. Trudy Salsberry for being my outside chairperson to support me. Thanks to all my colleagues from Midwest Equity Assistance Center, especially to the Director Dr. Charles Rankin, who provides me with the financial assistance and spiritual support to complete this project. And finally thanks to my dear parents, brother and numerous friends who endured this long process with me, always offering support and love.

CHAPTER ONE: INTRODUCTION

Learning Styles (LS) theory was introduced into the teaching and learning environment in the 1970's. Although there has been much research about learning styles, past research has scarcely begun to explore the possible role of Learning Styles in students' online collaborative learning. In order to take us beyond the research that discusses only the cause-effect connection between learning styles and learning results, this naturalistic case study focused on the exploration of students' participation behavior in the online text-based learning environment as it related to learning styles

Discussion in this chapter was organized in the following sections: (1) overview of the issues, (2) statement of the problem, (3) purpose of the study, (4) significance of the study, (5) limitations of the study, and (6) definition of terms.

Overview of the Issues

In today's society, more and more people are realizing that learning is no longer just for children. It is a central lifelong task essential for personal development and career success. This means that more nontraditional students are becoming the target audience of higher education. Nontraditional students, also called adult learners, fit one or more of the following criteria: 25 or older, married, parents, or have been out of school for an extended period, and who bring a wealth of experiences and practical knowledge to the learning environment.

Postsecondary institutions offer distance education to improve their ability to reach these new audiences as well as to increase enrollments and students' access to learning. According to the *Condition of Education 2004 Report* (Wirt et al., 2004), the number of courses in distance education nearly doubled between 1997–98 and 2000–01. In 2000–01, (compared to 34% 3 years

earlier) 56% of all postsecondary institutions offered distance education courses. Allen and Seaman (2004) reported that the total number of students taking at least one online course in the fall of 2003 grew to 1,971,397 up from 1.6 million in 2002, with a total of over 2.6 million students learning online by Fall 2004 (p. 5). With the growing demand for global education and global competence, distance education through technology at the postsecondary level becomes a necessity, to the extent that most colleges and universities offer certificates and degree programs designed to be completed solely through distance education. Many adults who have to return to school take advantage of online courses.

Allen and Seaman (2004) specified four sorts of courses in their study: (1) Traditional class: the course was delivered in writing or orally, with no online technology used. (2) Web facilitated class: the course was essentially a face-to-face course with 30% of the course facilitated by web-based technology, as for example, a course management system (CMS) or web pages to post the syllabus and assignments. (3) Blended/Hybrid: the course used both online and face-to-face delivery. The proportion of content delivered online ranged from 30% to 79%. (4) Online learning was defined as having at least 80% of the course content delivered online typically without face-to-face meetings. The authors stated that online education was a "critical approach to the long term strategy" of American higher education (Allen and Seaman 2004, p. 12), which helped meet nontraditional students' requirements to keep up their 'state-of-the-art' skills. Based upon the Wirt, Choy, Rooney, Provasnik, Sen and Tobin (2004) report for the United States Department of Education, a majority of the institutions that offered distance education in 2000–2001 indicated that increasing student access in various ways was a very important goal to their institution's distance education program. Sixty-nine percent of the institutions believed that it was very important to increase student access by making courses available at convenient

locations, and 67% reported that increasing access by reducing time constraints for course taking was very important. In fact, with wide use of the computer and Internet, Computer-Mediated Communication (CMC) has brought people from different places to participate in distance education classes which enable them to learn at their own pace and schedule. The majority of higher education institutions (90%) reported that they offered Internet courses using asynchronous computer-based instruction as a primary mode of instructional delivery, and 43% offered Internet courses using synchronous computer-based instruction (Wirt et al., 2004). There is a growing amount of research indicating that CMC methods (email, chat, web board, listserv, etc.) all play a critical role in the quality of communication and information exchange in online courses (Wells, 2000; Hassenplug & Harmish, 1998).

One of the many objectives of online teaching is to help learners to utilize their strongest learning style via the Internet to achieve their educational goals. Koschmann (1996) argued that "existing educational systems are producing individuals who fail to develop a valid, robust knowledge base; who have difficulty reasoning with and applying knowledge; and who lack the ability to reflect upon their performance and continue the process of learning" (p. 85). Teaching and learning environments should be improved to support the instructor-learner, learner-learner, and learner-content interactivity, a student-centered learning environment, and a system for students to discuss the ongoing construction of their knowledge (Moore & Cozine, 2000). Dede (1996) claimed that collaborative online learning would better prepare students for the requirements of today's global industries, where people who are involved in common projects are geographically separated. In a collaborative learning setting, emphasis is placed upon the interactions in which common understandings have been negotiated and developed overcoming differences in knowledge, skills, and attitudes. Bernard (2000) and his colleagues concluded that

using new technologies in combination with a collaborative online learning approach might prove to be highly effective when learning characteristics and the learning context were considered carefully. Meanwhile, the increased use of the Internet in higher education has helped researchers conduct collaborative research and has enabled faculty to provide opportunities for students to work collaboratively in their courses (Murphy, Cifuentes & Shih, 2004).

On the other hand, tools like the computer, Internet, or online learning do not diminish the importance of instructional design to provide high quality education. Rather than purchasing expensive equipment, Moller, Harvey, Downs and Godshalk (2000), emphasized that the instructional designer needs to pay more attention to individualized learning. That is, instructional design goals should fit the needs and learning styles of users and the requirements of instruction. Research has shown that the most successful learning happened because of a match between teaching style and learning style (Becan 2004, Brudnell & Carpenter 1990; Kramer-Koehler et al. 1995; Miller 2001; Sarasin 1998).

Statement of the Problem

Unfortunately many educators' knowledge of learning styles is often limited to a rather surface familiarity with Howard Gardner's (1993) research on Multiple Intelligences (MI), which was considered as a breakthrough when it first appeared. However, learning styles research is not limited solely to MI. Indeed, the reason why educators might not consider students' learning styles may be due to lack of knowledge about their diversity. If educators should choose to discover their students' individual learning style, they would realize that there is an abundance of learning style models. Educators could be overwhelmed in their choices of a model, which might lead to the abandonment of exploring their students' learning styles further.

With so many learning style models, differences are bound to exist. Kolb (1999) says that a learning style is a result of hereditary equipment, past experience, and the demands of the present environment. In his Experiential Learning Theory (ELT), four basic learning modes are proposed: Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualizations (AC), and Active Experimentation (AE) combined to produce four individual orientations: Diverging, Assimilating, Converging, and Accommodating. Dunns (1999) claims that learners are affected by their environmental elements (sound, light, temperature, and the need for either a formal or informal design) and stimuli (emotional, sociological preferences, physiological strengths and processing tendencies). Gregorc (1982) emphasizes that a learning style consists of distinctive, observable behaviors, and that learning happens in a duality combination: 1) concrete-sequential, 2) concrete-random, 3) abstract-sequential, and 4) abstract-random. Canfield and Lafferty (1988) highlight the attitudinal and affective dimensions through the exploration of conditions (academic, structural, and achievement), content, mode and expectation level. I discuss current frameworks of learning styles in Chapter 2. The instrument used in this study was Kolb's Learning Style Inventory (LSI).

Based on the limited number of available studies on the relationship of learning styles to student success in an online learning environment, there are two trends. The first trend focuses on the comparison between an online and an on-site learning environment. Some findings have indicated there was not much difference. That is, learners could be just as successful in an online environment as they could in the face-to-face environment, regardless of their learning style preferences (Gunawardena & Boverie, 1993; Haseman, Polatoglu, & Ramamurthy, 2002; Larsen, 1992; Marks & Sibley, 2001; Wang, Sierra, and Folger, 2001). The second trend is a focus on student learning outcomes such as achievement, efficiency, and satisfaction (Bacon, 2004;

Brudnell & Carpenter, 1990; DeBello, 1985; Miller, 2001; Perrin, 1985). This kind of research has attempted to find a cause-effect relationship between learning styles and learning outcomes. These findings have indicated that there is no significant difference in student outcomes as a result of different learning styles. Some studies have concluded that the online learning environment could facilitate students' learning even though they might have different learning styles, but there was no explanation of the details of how this process might function. The research could be improved by exploring the possible role of learning preference and style related to the effectiveness of the participant behaviors and learning activities. Since there is a need to further explore this area, I chose to focus the study on this topic.

Limited research has been conducted to understand the processes related to online collaborative learning. Collaborative learning has been introduced to encourage knowledge construction in the online learning environment in which learners are sharing their own understanding, and trying to negotiate a shared understanding. In this case, questions like "Do students' learning styles really play an important role in the online learning process? How do students with different learning styles collaborate with each other in online text-based CMC learning environment?" are important questions that warrant further exploration. Based on the findings of this research, recommendations for online instructional design to improve this course and similar courses will also be discussed.

Purpose of the Study

The targeted research setting was an online course called *Learning Technologies* delivered through Blackboard (course management system) in a College of Education at a large university in the Midwest. The primary audiences for this course were in-service teachers, graduate students in educational technology, and a few pre-service teachers. This course was delivered

totally online using such tools as threaded discussion, chat, and email. As a non-participant observer, I had the chance to observe the class for several semesters and also have provided technical support. Based on my observations, I have found that students contributed in distinctly different ways to online collaborative projects.

Learning Technologies is a course about integrating technologies to improve learning and understanding. Online class discussions, student initiative / leadership, general participation, timeliness, and preparedness were very important for learning (course syllabus). Activities including online discussions were required for students to accomplish their group projects. How students learned and what they learned in this course was better represented by their online discussion and performance in the online collaborative learning environment, more than by the final course grade. This was why I chose to observe and analyze the students' discussion and collaborative performance behavior and students' learning styles rather than incorporating the students' final test score into the study.

The purpose of this study was to explore students' different learning styles and students' collaborative participatory behaviors in an online text-based learning environment. Additionally, I was interested in whether the technology-rich environment that aimed to promote collaborative and project-based learning could play a role in learners' participation behavior as it related to learning styles. The study might help us to understand better whether educators should make a change in their instructional approaches or whether students need to adjust their styles in order to better adapt to the course. Finally, the study explored strategies for forming discussion groups in the online learning environment as they related to students' different learning styles. This was a descriptive case study as defined by Yin (1994) who describes a descriptive case study as one in which "a 'how' or 'why' question is being asked about a contemporary set of events over which

the investigator has little or no control" (p. 9). Taking into consideration the nature of research questions, time and setting boundaries, and the desired purpose of the research, this research is largely naturalistic in nature. However, categorical data collected by the Learning Style Inventory (LSI) results would be used to support findings.

Research Questions

The initial research question guiding the study was: How do groups made up of different combinations of learning styles engage in collaborative learning, and what is the nature of the engagement?

This question, in turn, suggests many avenues of exploration and questioning: what role do individual learning styles play in individuals' online collaboration behaviors? Is the preferred learning style actually used in online discussion and collaboration even when another learning style might be more effective, or do students use less preferred but more effective learning styles? Do some combinations of learning styles in a collaborative group seem to support collaboration better than other combination?

Significance of the Study

The increased use of the Internet in higher education has helped researchers conduct collaborative research and has enabled faculty to provide opportunities for students to work collaboratively in their courses. The ideal learning environment is one in which students with a common learning goal can share experiences, construct ideas and apply information, to collaboratively solve problems, regardless of when and where the students live, study, and originate those contributories. However, clear instructional strategies and guidance to facilitate

students' collaborative learning through computer-mediated communication is still at a developmental stage.

It is the researcher's expectation that this study could help educators better understands student participation in the online learning environment, and that from this understanding they may be able to improve their instructional design, in terms of encouraging collaborative discussion and teamwork in the online learning environment, and guide the development of similar courses in colleges of education.

Limitations of the Study

Every study conducted has its limitations. Limitations of this particular study were as follows: the primary data sources were collected from students' discussion postings and project reflections. The messages they sent to each other by email or other means of communication between students such as face-to-face meetings, phone calls, etc., were not part of data collected. The study would have been better if all such data could have been available to be analyzed.

An important limitation was the inability to form groups based on specific learning preferences, in which could help increase our understanding of students' interactions behaviors by comparing heterogeneous group with different learning styles and homogenous group with one specific learning style. However, this on-purpose group formation might or might not be possible in classroom situations, and thus the self-selection of students as they joined groups in this study might provide insight into what happened in real-life settings.

Definitions of Terms

Learning Style: Characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" (Keefe, 1979, p. 4).

Cognitive Style: a system and habitual mode of organizing and processing information (McLoughlin, 1999, p. 223).

Experiential Learning Theory (ELT): a model of the experiential learning process (Kolb, 1984, p. 20). [See Chapter 2 for an extended discussion of this theory.]

Learning Style Inventory (LSI): a framework for examining one's approach to learning situations, and an instrument for determining one's learning style (Kolb, 1984).

Computer-Mediated Communication (CMC): communication between different parties separated in space and/or time, mediated by interconnected computers (Romiszowski & Mason, 2003, p. 378).

Collaborative Learning: an approach to teaching in which students are required to work together, and to reach a consensus through negotiation to accomplish group tasks (Bruffee, 1993, p. 67).

BlackBoard: an industry-leading software application that is used as a platform for distance learning programs to power virtual learning environments and supplement classroom education (Blackboard Inc. 2005, p. 3).

Descriptive Case Study: a research methodology which is believed that "a 'how' or 'why' question is being asked about a contemporary set of events over which the investigator has little or no control (Yin, 1994, p. 9).

Content analysis: a generic name for a variety of textual analyses that typically involves comparing, contrasting, and categorizing a set of data (Schwandt, 1997).

MUD: (**Multi-User Dungeon** or **Domain** or **Dimension**) is a multi-player computer game that combines elements of role-playing games, hack and slash style computer games and social instant messaging chat rooms. Typically running on a bulletin board system or Internet server, the game is usually text driven, where players read descriptions of rooms, objects, events, other characters, and computer-controlled creatures or non-player characters (NPCs) in a virtual world. Players usually interact with each other and the surroundings by typing commands that resemble a natural language, usually English.

MOO: is a type of MUD and is a text-based online virtual reality system to which multiple users are connected at the same time.

CHAPTER TWO: LITERATURE REVIEW

Introduction

Because new information technologies enable new types of communication and interpersonal interaction, Computer-Mediated Communication (CMC) has become common in educational institutions. Collaborative learning has gradually become one of the main learning models used by faculty in CMC learning environments. In order to really understand collaborative learning online it is important to learn more about how individual learning styles interact in this environment. Dede (1996) in his study claimed that working in collaborative teams allowed students to combine complementary backgrounds and learning styles to develop communication skills. However, few studies have been done to support this claim. The need to study the interaction between online learning and collaborative learning is undeniable. In this literature review section, I start from the introduction of the concept of *learning style* and related research, then discuss the different learning style instruments and related research, and end with a discussion of Computer-Mediated Collaborative Learning. The purpose is to give a clear theoretical basis for the current study.

Learning Styles

> *"When students cannot learn the way we teach them, we must teach them the way they learn" (Dunn, 1990, p. 15).*

Keefe (1979) described learning styles as "characteristic cognitive, affective, and physiological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment" (p. 4). Although some researchers have used the terms interchangeably —learning styles and cognitive styles– Keefe's definition clearly

distinguishes between the two. The former is a broader term that includes cognitive, as well as affective and physiological style.

Learning Styles and Teaching

There has been a great deal of controversy about the topic of whether teaching styles should be modified to meet the students' learning styles. Since the Dunns (1993; 1981) demonstrated that students achieved statistically higher test and attitude scores when they were taught with approaches and resources that complemented their learning styles, there has also been more recent research linking successful learning with a match between the teaching style and the learning style (Bacon, 2004; Brudnell and Carpenter, 1990; Kramer-Koehler, Tooney & Beke, 1995; McLoughlin, 1999; Miller, 2001; Perrin, 1985; Sarasin, 1998).

Bacon (2004) found that when the learning environment matched a student's learning style, the student's learning was enhanced. A similar conclusion has been drawn by other researchers. Brudnell and Carpenter (1990) demonstrated that although students learned when instruction was provided through strategies that did not complement their learning styles, significantly higher test scores resulted when students were taught with strategies that did complement their learning style preferences. Studies have also indicated that students who were permitted to learn through their preferred style had statistically higher achievement and attitude scores (DeBello, 1985; Perrin, 1985).

Miller (2001) argued that student motivation and performance improved when instruction was adapted to student learning preferences and styles. Educators should understand the diversity of their students' learning styles and present information in a variety of ways in order to accommodate all learners' preferences. In fact, Kramer-Koehler et al. (1995) found that adjusting teaching to meet students' learning style preferences substantially benefited students. "By

offering students a variety of classroom and learning environments, students with different learning style preferences and skills may have a better opportunity to discover what best fits their own strengths, needs, and weaknesses ”(Kramer-Koehler et al., 1995, p. 4a2.5). Sarasin (1998) noted that instructors should be willing to change their teaching strategies and techniques based on an appreciation of the variety of student learning styles. “[Teachers] should try to ensure that their methods, materials, and resources fit the ways in which their students learn and maximize the learning potential of each student” (p. 2). McLoughlin (1999) also found that individuals learned best when information was presented in ways that were congruent with their preferred styles.

Kolb (1984) also has concerns about the misuse of learning style concepts, specifically, when people turned these ideas into stereotypes. Instead of focusing only on the consistency between learning styles and instructional design, educators should also recognize that the context is very influential. Many individuals can change their learning strategies in response to the unique instruction, content, and text. It is not enough to expose learners only to educational environments that match their strengths. The findings of the research conducted by McNeal and Dwyer (1999) to investigate the relationship between students’ learning styles and methods of instruction indicated no significant difference in learning between instruction that was designed in agreement with students’ learning styles and instruction designed in disagreement with students’ learning styles. In fact, Sarasin argued, “strengthening lesser-preferred learning styles helps students to expand the scope of their learning, become more flexible learners, and adapt to the requisites of the ‘real world’” (1998, p. 38).

Learning Styles and Online Learning

Previous studies of the learning styles of individuals have focused on the comparisons of the learning outcomes of students with different learning styles in a traditional in-class environment and those taking the same course via distance education. Most of this research showed there was no significant difference between these two learning environments in terms of the effects of the learning styles. That is, learners can be just as successful in the online environment as they can in the face-to-face environment, regardless of their learning style preferences. On the other hand, some studies have failed to detect significant relationships between learning styles and both the effectiveness of and satisfaction with computer-mediated learning.

Haseman, Polatoglu, and Ramamurthy (2002) investigated the influence of interactivity on the learning outcomes of users in a multimedia systems environment. The findings of the research indicated that there was no effect of learning styles on the relationship between interactivity and user outcomes. Similarly, the other researchers showed that learning styles were non-significant predictors of learning in distance education, pedagogies had marginal impact, and the interaction effects of learning styles and pedagogies had no effect (Marks and Sibley, 2001; Takacs, Reed, Wells, & Dombrowski, 1999). Being more specific, Gunawardena and other researchers compared the interaction of learning styles and multimedia, methods of instruction, and group functioning in a distance learning class using audio, graphics, and CMC, with similar interaction in a traditional class. The findings showed that learning styles did not impact how students interacted with media and methods of instruction, but did affect satisfaction with media, methods of instruction, group satisfaction, goal setting, and group climate (Gunawardena and Boverie, 1993; Miller, 2001). Larsen's (1992) study also indicated there was no significant difference in student learning outcomes when using interactive video instruction to teach. Effectiveness and satisfaction were independent of students' learning style preference.

Wang, Hinn, and Kanfer (2001) conducted research to explore the possible relationships between students' learning styles and their satisfaction with the collaborative learning environment and learning outcomes. The authors used ANOVA and t-test to compare pre- and post-course surveys. The results showed there were no changes in student learning styles and no significant differences in learning outcomes and learner satisfaction with regard to different learning styles between these pre- and post-tests. The authors further suggested that "the within-group variance may have concealed real differences" (Wang et al., 2001, p. 80) and collaborative learning environments might support a multitude of diverse learning styles. As the authors explained, the study focused on the students' cognitive achievement in term of final grades because this was easy for measurement and statistical analysis (p. 81). They recommended exploring the students' collaboration skills for future research.

Administering the *Grasha-Riechmann Student Learning Style Scales (GRSLSS)* (Grasha, 1996), Diaz and Cartnal compared the learning styles of online health education students and their face-to-face counterparts. The results indicated that "Local health education students enrolled in an online class are likely to have different learning styles than on-campus students" (Diaz and Cartnal, 1999, p. 134), that is, online students tended to be more independent and on-campus students more dependent throughout the learning process. This research further indicated that online students appeared to be driven more by intrinsic motives and on-campus students were more willing to work in class, provided they could obtain rewards for working with others.

Gee (1990), administered the *Canfield Learning Styles Inventory (CLSI)* to examine the influence of student learning style preferences, in an on-campus or distance education remote classroom, on student achievement in regard to the course content, course completion rates, and attitudes about learning. The outcomes indicated that successful distance education students

favored an independent learning environment while successful on-campus students showed a preference towards working with others. A student who had an independent and conceptual learning style had the highest average scores in all of the student achievement areas, while students with a more social and conceptual learning style had the lowest scores. Maybe this finding is because early distance learning, pre-1990, was pretty much defined as independent learning. Not much collaborating going on. Students with both a social and applied learning style performed much better in the on-campus class. The reasons that were discussed were that in the computer-mediated distance environment, the students would have a greater opportunity to observe rather than take immediate action, and have more time to combine experience with reflection, since he or she was not bound by the time constraints of the traditional classroom learner.

In this sparse literature exploring the relationship between learning style and the online learning environment, different learning style instruments were administered and, not surprisingly, the research findings were very diverse. Some of the instruments had reliability issues. Most of the research intended to explore the cause-effect relationship between learning styles and learning outcomes rather than studying collaborative skills in an online learning environment. The purpose of the current study was to explore the participatory behaviors of students with different learning styles in a text-based computer-mediated communicative learning environment; and whether some group combinations in terms of learning styles seemed to work well in the collaborative learning environment.

Various Learning Style Instruments

Dunn et al. (1981), Karagiannidis and Sampson (2004), DeBello (1990), Lemire (2001), Wilson (1998), McLoughlin (1999) and Campbell (1991) conducted many studies comparing

different learning style studies in terms of their instruments, applications / implications, and they concluded that each of them contributed substantially toward understanding how students learned. The instruments varied in format, length, and complexity. Some required special training to administer and interpret, whereas others could be given by following a few simple directions. Some instruments were multidimensional, encompassing cognitive, affective and psychological characteristics (*Dunn and Dunn Learning Style Model*), and others were limited to a single variable, most frequently from the cognitive or psychological domain (*Kolb's LSI, MBTI*). Though the different instruments have many similarities and basically attempt to measure learning style preferences, the terminology used to label the learning styles varies widely. Some learning style models insist that students' style should be changed, and others urge teaching to the individual's strength (*Gregorc-Mind Style and Gregorc Style Delineator, Dunn and Dunn Learning Style Model*).

What follow is a brief description of some of different Learning Style Inventories that I have found in the literature currently available in the field.

The Grasha-Riechmann Student Learning Style Scales (GRSLSS), (Grasha, 1996) is a 90-item self-report inventory which measures the preferences of both high school and college students. It consists of six categories:

- Avoidant (takes little responsibility for learning)
- Participative (accepts responsibility for self-learning and relates well to peers)
- Competitive (suspicious of peers)/Collaborative (enjoys working harmoniously with peers)

- Dependent (becomes frustrated when facing new challenges not directly addressed in the classroom)/Independent (prefers to work alone and requires little direction).

Although the researchers emphasized that this instrument seems ideal for assessing student learning preferences in a college-level distance learning setting (Diaz & Cartnal, 1999 p. 135), there is little evidence of the validity of the instrument. Grasha himself has grown dissatisfied with it (Grasha, 1996). Studies on the instrument's validity are limited and lack in strictness and care for detail. The instrument's focus on college students makes it of limited use in adult education.

Dunn and Dunn Learning Style Model (Dunn & Dunn, 1999)

This instrument includes two parts: (i) Learning Style Inventory (LSI) designed for children of grades 3-12 containing 104 items, and (ii) Productivity Environmental Preference Survey (PEPS), an adult version of the LSI containing 100 items. The Dunns' Learning Style Model is complex and encompasses 5 strands of 21 elements that affect each individual's learning. Some of these elements are biological and others are developmental. Style changes over time. A summary of these elements is provided below:

(a) The classroom environment (sound—such as music—versus quiet, bright or soft illumination, warm versus cool temperatures, and conventional desk and chair seating versus informal easy chairs)

(b) Emotionality (motivation, persistence, responsibility, and structure)

(c) Sociological preferences (learning alone, in a pair, with peers, in a team, with an authoritative versus collegial adult, and needing variety versus patterns or routines)

(d) Physiological strengths (auditory, visual, tactual, kinesthetic memory, intake—the need for snacks or liquid while learning, time-of-day energy levels, and the need for mobility versus passivity)

(e) Processing inclinations (global versus analytic, hemispheric, and impulsive versus reflective).

The first part of the instrument is most suitable for the school-aged children in the United States, and adult version has applications outside of the school setting. The author, Rita Dunn, believes that "If individuals have significantly different learning styles– as they appear to have – is [it] not unprofessional, irresponsible, and immoral to teach all students the same lesson in the same way without identifying their unique strengths and then providing responsive instruction?" (1993, p. 4).

Although the Dunns' LSI has "impressive reliability and construct validity" (DeBello, 1990), one criticism of the Dunns' approach is that the two-part instrument contains more than 200 items, which will require approximately one hour to administer. And more important, there is no research support for its use in higher education (Dunn and Griggs, 2000).

The Learning Styles Questionnaire (LSQ) developed by Honey and Mumford (Honey & Mumford, 1992) consists of 80 items with true/ false answers (Swailes & Senior, 1999). Taking from Kolb's original concept of a learning cycle of different learning styles, Honey and Mumford identify four types of learners:

- Activists (e.g. enjoy new experiences, make intuitive decisions, dislike structure)
- Theorists (e.g. focus on ideas, logic and systematic planning, mistrust intuition)
- Pragmatists (e.g. favor practical approaches, group work, debate, risk-taking), and

- Reflectors (e.g. observe and describe, try to predict outcomes, try to understand meaning).

According to Honey and Mumford (1992), individuals tend to rely on one of these approaches when they are engaged in learning. This inventory was originally designed for business. One concern with this instrument is that this test worked in a realistic situation, but the researcher worried that the underlying conceptual framework for the HM test was unsound. In order to assess the validity of the LSQ, Swailes and Senior (1999) conducted a survey of 329 British managers. The research results indicate that the factor structure of the LSQ does not cleanly reflect the four-stage Learning Cycle relied upon for a theoretical foundation. The author further concluded, "until the LSQ is enhanced to show stronger construct validity, efforts to associate it…will be inconclusive and misdirected" (Swailes & Senior, 1999, p.10). And there is no support for using this instrument as a measurement of learning style in education.

Solomon and Felder's Index of learning Styles (ILS) (Felder & Silverman, 1988) originally developed for engineering students, has 44 questions and focuses on four bi-polar preferences for learning scales:

- Active-Reflective (Active learners learn by trying things and working with others and Reflective learners think things through and work alone)
- Sensing-Intuitive (Sensing learners are oriented toward facts and procedures while Intuitive learners are more conceptual, innovative and focus on theories and meanings)
- Visual-Verbal (visual learners prefer visual representations of material such as pictures, diagrams and charts while verbal learners prefer written or spoken explanations)

- Sequential-Global (Sequential learners are linear and orderly in their thinking and learn in small incremental steps while Global learners are holistic thinkers who learn in large leaps) (Felder & Soloman, 1999).

Zywno (2003) used the Felder styles to conduct a study of the relationship between student learning styles and their academic achievement in hypermedia-assisted learning environment. By pointing out that ILS is a suitable psychometric tool for evaluating learning styles of engineering students, the author also emphasized that work on the instrument's evaluation should continue.

The researcher Bacon (2004) in his study pointed out that most of the subscales contained in the ILS had poor reliability. Since the reliabilities may vary from school to school, Bacon suggested that the researcher should first check the reliabilities of the measures that they plan to use as a foundation for their research.

Gregorc-Mind Styles (Gregorc, 1982) is a self-report inventory based on the rank ordering of four words in each of ten sets. The instrument has been separated as two sets of dualities in the acquisition of information: abstract vs. concrete and sequential vs. random. The two sets of dualities result in the following four learning preference modes (1997):

1. The abstract sequential learner. This individual is easily able to decode written, verbal, and image symbols. Symbols and pictures are important to this learner, as are presentations that are rational, substantive, and well-organized.
2. The abstract random learner. This person is skilled in sensing and interpreting atmosphere and mood. For this learner, the medium is associated with the message, and a speaker's manner, delivery, and personality are as important as what is spoken. Information is gathered

in an unstructured manner, reflected upon, and then organized into a pattern that makes sense to the learner.

3. The concrete sequential learner. This learner prefers hands-on experiences that use all five senses and step-by-step directions and well-ordered presentations and will defer to authority and guidance in the learning environment.
4. The concrete random learner. This person likes to experiment, comes to the crux of the matter quickly, and uses intuition in drawing conclusions. This learner prefers a trial-and-error approach to gathering information and does not welcome teacher intervention.

This instrument is similar in format and design to the Kolb Learning Style Inventory. Gregorc in his website answered the question regarding this word-association instrument stating that there is validity issue existing. And questionable results appear when this instrument is used to identify the classroom preference (Gregorc, 1999).

Canfield's Learning Style Inventory (Canfield and Lafferty, 1988)

This instrument is a self-report instrument based on a rank ordering of choices for each of 30 questions. It is used from junior high school age through adult levels. With the emphasis on attitudinal and affective dimensions, this instrument indicates that individual learning style is derived from:

- Academic conditions (relations with instructor and peers);
- Structural conditions (organization and detail);
- Achievement conditions (goal setting, competition);
- Content (numbers, words, etc.);
- Mode of preferred learning (listening, reading, iconic and direct experience);

- Expectation of performance level (superior through satisfactory).

In 1991, Verduin and Clark examined learning styles within the distance education setting and reviewed the research done on learning styles by Canfield. Although their conclusion showed that adults might or might not learn more easily when the style of the presentation matched the students' learning style, when the two did match the students reported being more satisfied with the course. However, there is no other related report about the reliability of this instrument except Canfield and Lafferty (1988).

Gardner-Multiple Intelligence Inventory (Gardner, 1993)

The theory of Multiple Intelligences (MI) suggests that there are a number of distinct forms of intelligence that each individual possesses in varying degrees:

- Linguistic intelligence: the potential to use language to express oneself and remember information;
- Logical-mathematical intelligence: the capacity to analyze problems logically and carry out mathematical operations and think scientifically;
- Musical intelligence: the skills to performance, composition and appreciation of musical patterns;
- Bodily-Kinesthetic intelligence: the potential to use one's whole body or part of the body to solve problem;
- Spatial intelligence: the potential to recognize and use the patterns of wide space and more confirmed area;
- Interpersonal intelligence: the capacity to understand the intentions, motivations and desires of other people;

- Intrapersonal intelligence: the capacity to understand oneself, recognizing one's own strengths and weaknesses;
- Naturalist intelligence: ability to recognize, categorize and draw upon certain features of the environment. It combines a description of the core ability with a characterization of the role that many cultures value (Gardner,1999).

Gardner has been very honest and forthright about the lack of experimental research on his theory, which he noted by saying, "while multiple intelligences theory is consistent with much empirical evidence, it has not been subjected to strong experimental tests…" (1993, p. 33). However, it challenges educators to take differences among students seriously and encourage students to assume responsibility for their own learning.

Denig (2004) identified the differences between MI and Learning Style models by stating that "The Multiple Intelligence stresses the need to change instruction to students' abilities, whereas learning style theory suggest changing instruction to students' learning style. .. MI addresses what is taught (the product); learning styles addresses how it is taught (the process)" (p. 106).

Experiential Learning Theory (ELT) and Kolb's Learning Style Inventory

In this section I examine the theory of experiential learning (Kolb, 1984), Kolb's learning style inventory and the related research to explore whether and how this knowledge could be used in this study.

Reviewing the previous work by John Dewey, Kurt Lewin, Jean Piaget, Carl Jung, Carl Rogers and others, Kolb (1984) developed a model of the experiential learning process called Experiential Learning Theory (ELT). This unique theory on learning and development is built on

six propositions that are shared by those scholars' learning process models (Kolb, 1984, p. 26-38):

- Learning is best conceived as a process, not in terms of outcomes, just as Bruner states: "Knowing is a process not a product" (Bruner, 1966, p. 72). "The purpose of education is to stimulate inquiry and skill in the process of knowledge getting, not to memorize a body of knowledge" (Kolb, 1984, p. 27).
- Learning is a continuous process grounded in experience. This implies that all learning is relearning. Everyone enters every learning situation with more or fewer ideas about the topic at hand, and the purpose of teaching is not only to implant new ideas but also to dispose of or modify old ones (Kolb, 1984, p. 28).
- The process of learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world. Conflicts, differences and disagreement are what drive the learning process. "Learning is by its very nature a tension- and conflict-filled process" (Kolb, 1984, p. 30).
- Learning is a holistic process of adaptation to the world. Taken from the Jungian theory of psychological types, this perspective portrays learning as a continuous, lifelong process and highlights adaptive activities like learning, creativity, problem solving, decision making, and scientific research. Learning involves thinking, feeling, perceiving, and behaving functions (Kolb, 1984, p. 31-34).
- Learning involves transactions between the person and the environment. The traditional educational process takes learning as a primarily personal, internal process requiring only the limited environment of books, teacher, and classroom. However, Kolb views learning

as an active, self-directed process in which individuals exchange their needs, values, and behavior patterns in the group setting (Kolb, 1984, p. 34-36).

- Learning is the process of creating knowledge. To be specific, Kolb believes that "learning is the process whereby knowledge is created through the transformation of experience" (p. 38). ELT proposes a constructivist theory of learning whereby social knowledge is created and recreated in the personal knowledge of the learner.

Hickox (1991) conducted a comprehensive review of the ELT/LSI literature that showed that overall 61.7% of the studies supported ELT, 16.1% showed mixed support, and 22.2% did not support ELT (p. 12).

Kolb describes two continua to help define the learning style of an individual: the learning modes of Concrete Experience (CE) and Abstract Conceptualization (AC) form the opposite ends of a learning continuum for *grasping* experience; and another two modes–Active Experimentation (AE) and Reflective Observation (RO)–form the other continuum for *transforming* experience. According to the four-stage learning cycle, immediate or concrete experiences are the basis for observations and reflection. These reflections are assimilated and distilled into abstract concepts from which new implications for action can be drawn. These implications can be actively tested and serve as guides in creating new experiences (Kolb, 1984).

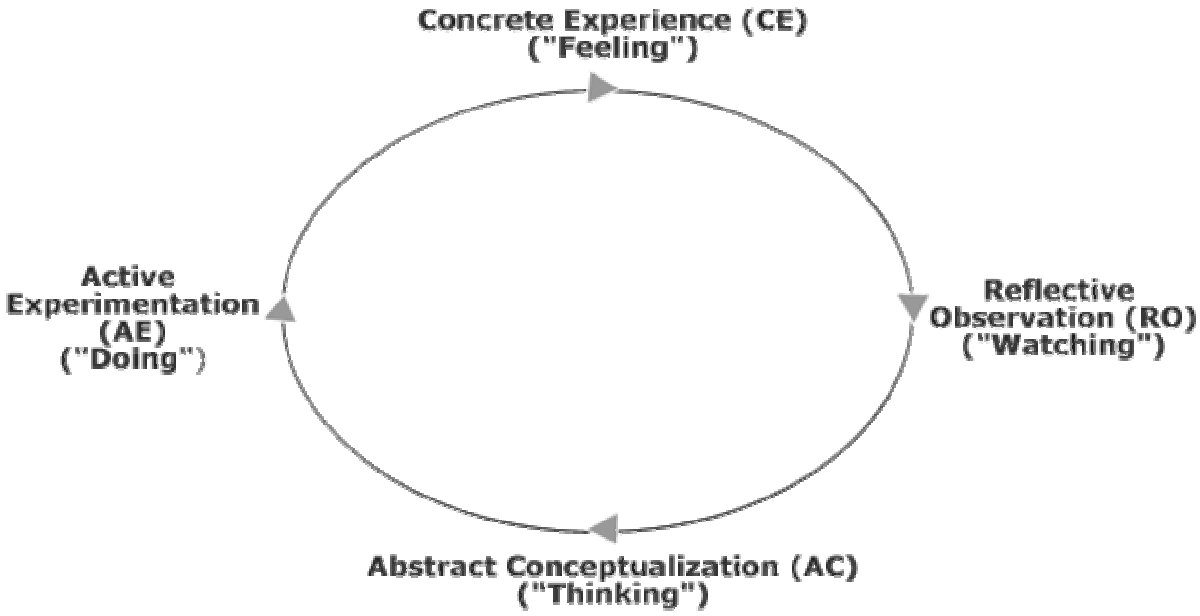

Figure 1. Four Learning Modes (based on Kolb, 1984).

According to Kolb and other researchers (2000), *Abstract Conceptualization (AC)* ("thinking") is the ability to theorize logically, integrating observation into concepts; *Concrete Experience (CE)* ("Feeling") is the ability to be involved in new experiences without bias or restraint. *Active Experimentation (AE)* ("doing") is the ability to act by making decisions and problem solving; *Reflective Observation (RO)* ("watching") is the ability to maintain multiple perspectives in observation and meditation. When a learner's preference has been determined on each of these two continua, they fall into one of these four learning styles, thus creating the four quadrants where each quadrant reflects a particular learning style: 1) Converging, 2) Diverging, 3) Assimilating, and 4) Accommodating (See Figure 2).

Learners with a *Convergent* learning style prefer Abstract Conceptualization (AC) and Active Experimentation (AE). They are good at problem solving, decision making and the

practical application of ideas. They like to deal with technical tasks and problem rather than social and interpersonal issues.

Divergent style learner strengths are Concrete Experience (CE) and Reflective Observation (RO). They have strong imaginative ability and the awareness of meaning and values. They are good at 'brainstorming.'

Assimilation style learners gravitate towards Abstract Conceptualization (AC) and Reflective Observation (RO). They are good at inductive reasoning and the ability to create theoretical models. They are more concerned with ideas and abstract concepts. It is important for them that the theory be logically sound and precise than for it to have a practical application.

Persons who belong to the *Accommodative* style emphasize Concert Experience (CE) and Active Experimentation (AE). They are good at doing things, carrying out plans and tasks and getting involved in new experiences. They solve problems in an intuitive trial-and-error manner and rely heavily on other people for information rather than on their own analytic ability.

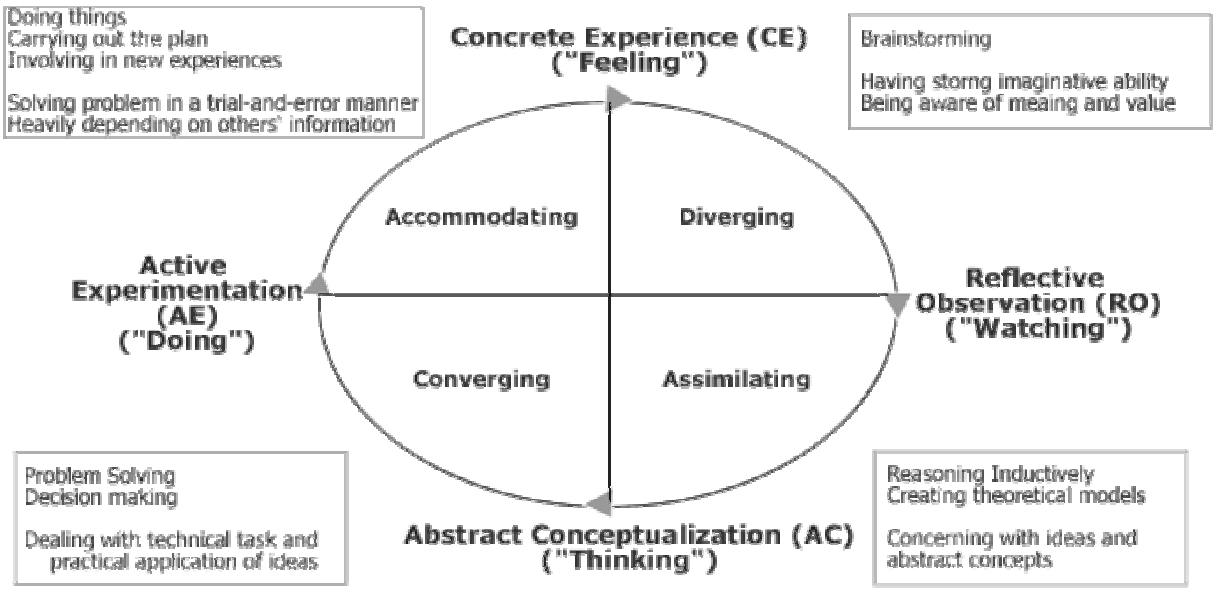

Figure 2. Four Learning Styles (based on Kolb, 1984).

In addition to Kolb's research, there are many researchers who also describe the same characteristics of the four learning styles (DiBartola, Miller & Turley, 2001; Dixon, 1982; Reiff, 1992; Sugarman, 1985; Svinicki & Dixon, 1987). Judith Reiff (1992) explains Kolb's four learning modes as stages in the similar way. The concrete experience stage (CE, feeling) emphasizes learning from particular experiences and special awareness of other individuals and feelings. The reflective observation stage (RO, watching and listening) has people looking at different points of view and reflecting before making decisions. In the abstract conceptualization stage (AC, thinking), learners depend on reason and theory to understand the problem. During the active experimentation stage (AE, doing), learners prefer being involved and seeing how things really work. Once the learner has acquired some concrete experience that provides a basis for reflective observation on the experience, using both the experience and the reflective observation, the learner forms some abstract concepts (or theory). The learners can then test or use his/her theory through active experimentation.

According to DiBartola et al. (2001), Concrete Experience abilities are dominant when a person uses feelings more than a systematic approach to problem solving. When Abstract Conceptualization is dominant, one learns best by using logic and ideas to solve problems. Active Experimentation approaches problem solving by attempting to influence and change situations and environments. Those who learn best by using Reflective Observation skills are most comfortable solving problems by careful judgment based on patience and objectivity (p. 112-113).

Dixon (1982), Sugarman (1985), and Svinicki and Dixon (1987) have also supported Kolb's paradigm in a number of studies. These researchers state that the Accommodator has the ability to be involved in new experience without bias or restraint and has the ability to act by making

decisions and problem solving. The Diverger has the ability to be involved in new experiences without bias and restraint and has the ability to maintain multiple perspectives in observations and contemplation. The Converger has the ability to theorize logically, integrating observations into concepts, and has the ability to act by making decisions and problem solving. The Assimilator has the ability to theorize logically, integrating observations into concepts, and has the ability to maintain multiple perspectives in observation and contemplation.

In 1971, Kolb developed the *Learning Style Inventory (LSI)* to provide a framework for examining one's approach to learning situations. *LSI* is a 12-item self-description questionnaire where each item asks the respondent to rank in order four words that best describes the respondent's preferred learning style (Kolb, 1984; 1999).

The respondent is asked to use a rating scale from one through four as follows:

a) four (4) best characterizes his or her learning style,
b) three (3) to the work which is next best at characterizing the respondents' learning style,
c) two (2) to the next most characteristic word,
d) one (1) to the word which is least characteristic for him or her as a learner.

The scores of the four basic learning styles are derived by summing the rank numbers assigned to the words that correspond to each of the learning modes. The learning mode receiving the highest score is considered to be the preferred learning style of the respondent (Kolb, 1999, p. 5).

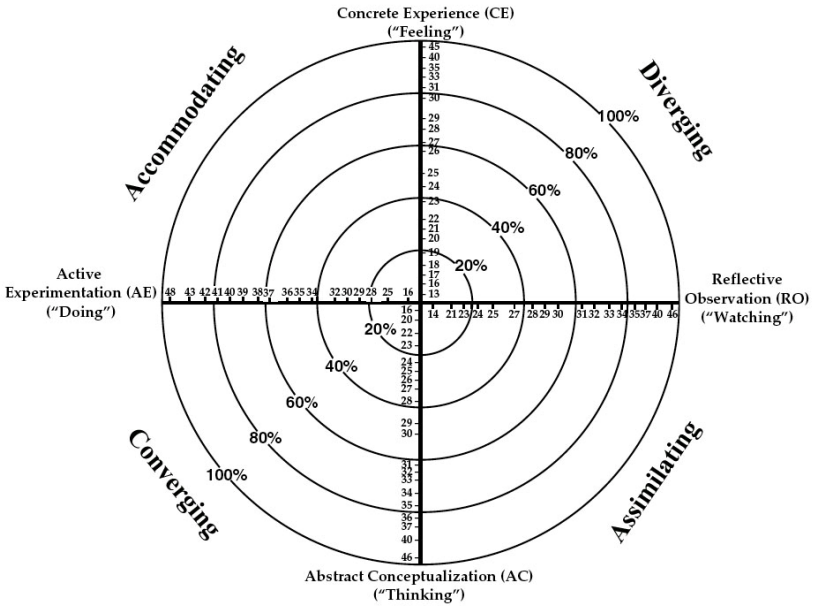

Figure 3. The Cycle of Learning (adapted from Kolb, 1999, p. 3).

Any measurement must be both reliable – measurement yields consistent, repeatable results—and valid it measures what it is supposed to measure. The first is an issue of reliability, the second of construct validity. Debate and criticism of the Kolb instrument focused on its test-retest reliability. Curry (1987) stated that Kolb's instrument had strong reliability but only fair validity. Federico (2000), by giving 711 participants these two instruments, reported test-retest reliabilities of the four learning mode scales: Concrete Experience, .92; Reflective Observation, .93; Abstract Conceptualization, .94; and Active Experimentation, .91, all high reliabilities. Heffler (2001) used the test-retest correlation coefficients for the different learning modes as a measure of the reliability of the instrument. All the reliability coefficients were highly significant. That is to say, the results indicated that the learning style of the individual

could be reliably measured with this inventory (Heffler, 2001, p. 310). According to Veres, Sims and Locklear (1991), randomizing the order of the LSI version 2 items resulted in dramatic improvement of test-retest reliability (p. 9). This finding led to the improvement of the latest LSI revision, which was used in this current study.

My intent in this study was to come to understand such things as:

- Whether learning styles play a role in the students' online learning;
- Whether the preferred learning style is actually used in online discussion and collaboration even when another learning style might be more effective, or whether students sometimes use less preferred but more effective learning styles;
- Whether the use of the preferred learning style changes over time in the collaborative learning environment toward a more efficient or effective style for that environment;
- Whether some combination of learning styles in a collaborative group seem to work particularly well or whether some other combination appears to be particularly frustrating for group members.

In the current study, Kolb's Learning Style Inventory (LSI) was administered to the students to explore how students with dissimilar learning styles collaborate with each other in the asynchronous communication environment.

Research on Kolb's Learning Style Inventory

With the continuous development of online distance education, some researchers have conducted studies to examine instructional methods, class satisfaction, attitudes, interaction and the learning environment, in terms of learning style (Bohlen & Ferratt, 1993; Federico, 2000; Gee, 1990; Gunawardena & Boverie, 1993; Simpson & Du, 2004; Takacs et al., 1999). The studies showed quite different results when looking at Kolb's four learning styles.

By using Kolb's LSI, Bohlen and Ferratt (1993) examined the effect of learning styles and instructional methods–lecture-based and computer-based (CAI)–at the level of college students who were learning a word processing package. This research used a two-way ANOVA to answer their research questions. The research focused on student learning outcomes like achievement, efficiency, and satisfaction. The independent variables were: learning style and method of instruction (lecture and computer-based teaching). The results showed that computer-based teaching was more efficient and satisfied than the lecture method except for Assimilators, who appeared to learn equally well under both lecture and computer-based methods, and that Convergers were the most satisfied with the computer-based instruction.

Comparing two different course delivery formats, DiBartola et al. (2001) studied the learning outcomes of students with different learning styles identified by Kolb's LSI. Their research found that learning styles did not appear to affect learning outcomes in either group, with the exception of the Divergent learning style that had a positive relationship to learning in the distance education environment. Those who learned best by Diverging strategies combined Concrete Experience with Reflective Observation. They were best at viewing concrete situations from many different points of view. The authors further explained that the computer-mediated distance environment gave those with Divergent learning style an advantage because it provided the chance for students to observe rather than take immediate action, and to have more time to combine experience with reflection.

Federico (2000) tried to determine student attitudes toward various aspects of computer-based instruction in terms of dissimilar learning styles. The students participating in the study came from different departments and were asked to complete the attitude survey and the Kolb Learning Style Instrument. Students with Assimilating and Accommodating learning styles

demonstrated a significantly more positive attitude toward varied aspects of computer-based instruction than did students with Converging and Diverging learning styles (Federico, 2000, p. 377). The author further concluded that taking into account the different learning styles, an instructional developer, acting as a facilitator, should help students to adapt to the online learning environment and try to optimize their interaction with the content and acquisition of knowledge. Aragon, Johnson, and Shaik. (2002) also showed that online students favored Reflective Observation (learning by watching and doing) in comparison to their face-to-face counterparts; and had a higher preference for Abstract Conceptualization (learning by thinking).

Gunawardena and Boverie (1993) compared the interaction of adult learning styles and media, methods of instruction and group functioning in a distance learning class to similar interaction in traditional classes. The finding showed that learning styles did not impact how students interacted with media and methods of instruction, but did affect satisfaction with other learners. The authors further explained that the Accommodators were the most satisfied with class discussions and group activities, the Convergers and the Assimilators showed moderate satisfaction and the Divergers were the least satisfied with group activities. The Accommodators, Convergers and the Assimilators in the distance class were much more satisfied with their overall learning experience than those in the traditional class. There was no difference for the Divergers (p. 6-8)**.**

Using the independent variables—learning style, total number of login hits, posts, and individual discussion postings during the semester—and the dependent variable—students' self-reported enjoyment level, Simpson and Du (2004) also conducted quantitative research in which they used Kolb's Learning Style Inventory to explore the effect of learning styles and online participation on students' self-reported enjoyment levels in distributed learning environments.

They used multiple regressions to analyze the data. Students' participation was recorded through pages accessed, pages read, and total postings made. The results indicated that learning styles significantly impacted students' enjoyment level but class participation did not. The study found that Converging students (abstract/active) liked the courses the most and Assimilating students (abstract/reflective) liked the courses the least. Diverging students (concrete/reflective) made the most 'hits' and 'reads,' and Assimilating students had the least 'posts.' It might be supposed that learners need many online activities such as online reading, emails, group discussion in the online course, and that those who liked to 'do' things would enjoy the course the most; however those who preferred to 'observe' in onsite environments would find themselves lost in online activities (p. 129-132).

Although there was an absence of a learning styles effect in the study conducted by Takacs and his colleagues (1999), they agreed that Accommodator and Converger were very significant predictors of students choosing classes with high computer use because both of these learning styles had "Active Experimentation" as a common learning mode. Accommodators learned from hands-on experience, and Convergers were best at finding practical uses for their ideas and theories. On the other hand, Jonassen and Grabowski (1993) argued that Assimilators and Divergers were more thought-intensive because they were both imaginative and intuitive and both used sound logic as an approach to problem solving. Divergers tended to be open-minded, and assimilators dealt well with systematic and scientific approaches (p. 342).

Whether students' learning styles affect or are affected by the learning environment was a big concern among researchers. Hofstede (1986) and Aragon et al. (2002) stated that the environment in which we interacted determined our cognitive development. Cohen (2001) believed that a student's learning style could, in fact, be altered and affected through the external

conditions set up in the environment. The results suggested that a technology-rich environment that promoted collaborative, project-based learning could have an effect on learning styles. The emphasis on teamwork would suggest that although students might find it stressful, they would also grow to enjoy and appreciate working with peers. Diaz and Cartnal (1999) pointed out that there had been few studies on the relationship of learning styles to student success in a distance learning environment. However, although online students preferred independent learning situations, they were willing and able to participate in collaborative work if they had structure from the teacher to initiate it. Some researchers (Gee, 1990) suggested that, although learning style preference might affect the academic achievement of distance learners, the environment of the World Wide Web (WWW or "the web") provided enhanced opportunities to accommodate flexibility in learning style. The technology of the World Wide Web allowed faculty to create learning environments that appealed to a variety of learning styles (p. 113).

The literature has shown inconsistent findings. Convergers were the most satisfied with the computer-based instruction (Bohlen & Ferratt, 1993), while in DiBartola's (2001) study, the Diverging learning style had a positive relationship to learning in the distance education environment. Federico (2000) found that students with Assimilating and Accommodating learning styles demonstrated significantly more positive attitudes toward varied aspects of computer-based instruction than did students with Converging and Diverging learning styles. Gunawardena & Boverie (1993) demonstrated that students with Accommodating learning styles were most satisfied with the group climate and class discussions, and the Accommodators, Convergers and Assimilators in the distance class were much more satisfied with their overall learning experience than those in the traditional class. However, Simpson and Du (2004) found that Converging students liked the online course most and Assimilating students liked the

courses the least. Most of this research was conducted quantitatively by counting students' login time, administering attitude surveys or comparing the students' final grades. Students' login time and number of the posts, however, cannot guarantee the students' collaborative learning. With this confusion of methods and findings, I designed this research to try a different strategy. In this study I began with the question "How do these [Kolb's] four learning styles affect students' collaboration in groups in the online text-based learning environment?" A case study with its thick description was conducted to explore whether the four Kolb-defined learning styles affected students' discussion behavior and whether and how the collaborative learning environment might be related to students' participation, even though they had different learning styles.

Computer-Mediated Communications

When distance education represents a process of teaching and learning in which participants are physically separated from each other, the possibility of learning free of time and place becomes the desire of many educators and potential learners. Moore (1987) stated that teaching and learning environments should support 1) Interactivity (instructor-learner, learner-learner, learner-content), 2) Student-centered control of pertinent information, and 3) Mechanisms for students to discuss the ongoing construction of their knowledge (p. 3).

Recent development of network and communication technologies provides the opportunity for the separated individuals to access to courses and instruction "in a timely and more interactive manner through increased communication, interactivity among participants, and incorporation of collaborative pedagogical models" (Schrum, 1999, p. 12). Harasim (1990) summarized that the characteristics of online courses as place and time independence, many-to-

many communication that fostered real collaborative learning and dependence on text-based communications to promote thoughtful and reflective commentary.

Computer-Mediated Communication (CMC) is "communication between different parties separated in space and/or time, mediated by interconnected computers" (Romiszowski and Mason, 2003, p. 378). Romiszowski further explained that CMC is a highly interactive, multi-way and synchronous or asynchronous communication. Those CMC technologies selected for delivery of instruction are either a synchronous (real-time) or an asynchronous (delayed-time) format, and the format chosen plays a critical role in the quality of communication and information exchange in online courses (Hassenplug and Harmish, 1998). Well-known examples are email, chat, threaded discussion, bulletin board, listserv, and MOOs/MUDs, among others Threaded discussion is the most used method in text-based and asynchronous computer-medicated communications system.

Most computer-supported learning is based on asynchronous (not-real-time) communication. By providing a conversational learning platform, three attributes of the asynchronous communication – time-independence, text-based communications, and computer-mediated interaction – encourage all the participants of the group to receive and respond to messages from all the other participants in a multi-way conversation (Harasim, 1990). Romiszowski and Mason (2003) suggested that discussion, brainstorming, problem solving, collaboration and reflection are best suited to CMC.

When time becomes more and more valuable and limited for today's students who have multiple demands placed on their time, including work and family obligations, students need to use their time efficiently and wisely. Asynchronous communication allows participants to choose when to respond to another participant's comment. They do not have to answer the questions

immediately, but have the time to reflect and to consult references or additional information resources which offers the benefit of critical thinking with a more structured, more complex response. Giving students the control of speed of the interaction, asynchronous group interaction increases opportunities for learners participating that may enhance the quality of decision-making since they have an opportunity to re-read articles as well as skipping some which they are already familiar with. By given sufficient time and quality instruction, nearly all students could learn (Carroll, 1963). Time-independent CMC is supposed to increase learning effectiveness. Indeed, the asynchronous approach does free the learners from the scheduled lecturer's pace or time. Romiszowski (2003) pointed out that convenience of access at the student's own time schedule was more important than the distance between the individuals. In fact, only the smallest group, full-time graduate students, used the system during weekdays, but the majority of the class who worked full time Monday though Friday used the system most heavily on the weekends (Harasim, 1987). By examining the students' learning time intensity, Hwang & Wang (2004) concluded that the more diligent the students, the higher was the quality and quantity of interaction.

Although recent technologies allow audio and video conferencing, this type of communication requires a degree of bandwidth that is not available everywhere. Text-based communication is still commonly used mainly because it does not cause any bandwidth problems. For asynchronous group discussion, text-based communication is useful because it contributes to a more reflective interaction (Harasim, 1990) and can be stored and structured more easily. Comparatively, in the face-to-face classroom all comments as well as the drawings on the blackboard are lost at the end of each session. Even if the teacher uses transparencies, which can be copied for the students, students' questions and comments are lost. Stored comments in the

asynchronous discussion makes all participants' discussion contributions accessible for later reading or review so that everyone can share information. Furthermore, text-based communication also requires students to reflect more carefully when they have to put their arguments into written words. Garrison and his colleagues (2001) assumed that low numbers for "integration (construction of possible solution)" and "resolution (critical assessment of solution)" were due to the fact that individuals would hesitate to offer inadequate solutions in a public setting in order to avoid rejection. The researchers showed that the reflective and clear text-based communication encouraged discipline and thoroughness in thinking and communicating (White, 1993; Garrison, Anderson & Archer, 2000).

On the other hand, there is an important social aspect to be considered. Some research has shown that asynchronous communication encourages timid students to express their ideas when there is no chance to meet peers physically; some has shown that when participants could not feel the presence of colleagues in an asynchronous discussion, that might cause "procrastination", leaving the response for later or even failure to respond (Romiszowski and Mason, 2003, p. 422). At times one can read between the lines to find out something about a person, but gestures, voice intonation, and facial expressions are lost in the text-based form of communication. Garrison (2000), suggested that some techniques such as use of emoticons or paralinguistic characters could add affective gear to computer-mediated dialogue (p. 15), for example: ☺, ☹, : - happiness, :-@ shock or screaming, LOL (laugh out loud), BRB (be right back), etc.(Tu and McLsaac, 2002; Wang, Sierra & Folger, 2003). Garrison contended that explicitly expressing appreciation and agreement as well as complimenting and encouraging others were textual tools for communicating recognition and support (2000). Moreover, the combination of synchronous and asynchronous communication would be the most ideal solution. Students should be able to

communicate and collaborate asynchronously via discussion board or email, but also synchronously with peers using chat tools if they choose to. Synchronous delivery is a time-bound delivery format. Students and instructors all meet together at a given time in order to participate in the teaching/learning process and to interact with each other. A live chat room on the Internet is the most employed in the CMC. Synchronous communication provides opportunities of quick feedback and instant conversation.

The effect of computer-mediated communication is not just adding new technology to old ways of organizing teaching and learning (Moore, 2000). Rather, CMC allows learners to find and develop their own style of learning and create their own meaning when learning new things. CMC promotes a type of interaction that allows learners the freedom to develop their own learning. Instead of being the passive receivers of knowledge, students are provided the resources necessary for independent exploration. Moreover, they can share their own expertise with their peers and instructors (Collins, 1991).

Due to the labor intensity of qualitative research and the expense and difficulty of contacting ex-CMC users, there is little use of qualitative approaches in the CMC studies (2003). The newly emerging acceptance of qualitative research in education was strongly influenced by Harasim (1987) who investigated the use of computer conferencing for creating new learning environments. Her study focused on the computer conference environment as a place for more "effective" (i.e. active) learning. She presented data on student participation, perceived effectiveness of learning, and perceived advantages and disadvantages of online learning--much of the data was of a qualitative nature, taken from student surveys. In fact, the investigation of the potential applications and specific methodologies for collaborative learning has become one of the most important research areas in recent years. Since CMC has been declared as uniquely

suited for collaborative study (Harasim, 1990), Hakkinen and his colleagues argued for the focus of CMC research: “methods should be developed not only for capturing processes and outcomes of learning, but also experienced effects and individual interpretations of participation in Computer Support Collaborative Learning settings” (Hakkinen, Jarvela & Makitalo, 2003, p. 402). Content analysis is one method of analysis that has taken on increased emphasis in CMC research, focusing on the quality of messages in relation to performance (Jeong, 2003, p. 26).

Collaborative Learning

“An essential feature of learning is that it creates a zone of proximal development. Learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with his environment and in cooperation with his peers” (Vygotsky, 1978, p 90). Vygotsky is the representative theorist of social constructivism, according to which point of view “meaning is a function of how the individual creates meaning from his/her experiences” (Jonassen, Mayes & McAleese 1993, p. 233). That is, learners construct their own meaning based on prior knowledge and experience. Constructivists emphasize that the development of critical thinking, problem solving and reasoning skills frequently involves interaction with other learners.

According to Vygotsky (1978), students were capable of achieving higher performance at higher intellectual levels when asked to work in collaborative situations than when asked to work individually. However, Jonassen, Mayes and McALeese pointed out that “traditional instructional design models focus more on the object of knowing (content) rather than on the process of coming to know” (1993, p. 70). Students have difficulty applying knowledge and lack the ability to reflect upon their performance to develop a valid knowledge base and fail to continue in their process of learning (Koschmann, Kelson, Feltovich, & Barrows, 1996, p. 85).

Meanwhile, modern society is characterized by rapidly expanding knowledge, such that students cannot be expected to master all the information by their own. Collaborative learning that was first introduced into the business learning environment, where students (or workers) are required to work in collaborative groups to develop analyzing, communicating and decision-making skills in their professional roles, has now become an important instructional method in the computer-based learning environment. Agreeing with Bruffee (1993), McAlpine (2000) defined the term "*collaborative learning*" as an approach to teaching in which students were required to work together, and to reach a consensus through negotiation to accomplish group tasks (p. 67).

This literature review showed that more and more researchers and educators supported a collaborative learning approach in computer-supported learning environment (Bernard, Rojo de Rubalcava, Beatriz & St-Pierre, 2000; Dillenbourg, 1999; McAlpine, 2000)

From a constructivist point of view, McAlpine stated, "collaborative learning processes encourage knowledge construction in an environment in which learners are sharing their own understanding, and trying to negotiate a shared understanding (2000, p. 69)." After reviewing various supportive studies on collaborative learning through the point of view of constructivist activity, McAlpine conducted an evaluation study to examine how collaborative learning theory had been applied in the development of an online course at the masters level offered by the Institute of Land and Food Resources at the University of Melbourne. A questionnaire, with a combination of a five-point Likert scale agreement/disagreement questions and open-ended comment questions, was developed for this evaluation. The results showed that students were positive about working closely with others. Regarding the issues of depth of understanding of the topic, the development of problem solving skills, and relevance of the course materials to the

student's current professional involvement, the responses ranged from generally positive to strongly positive (2000, p. 76).

Bruffee and other researchers distinguished *collaborative* learning from *cooperative* learning by stating that in collaborative learning, the emphasis lay in the mutual engagement of learners in the learning process rather than solely on a division of labor to reach a common group goal (Abrami and Bures, 1996; Bruffee, 1993)**.** Another researcher, Dillenbourg gave a clear explanation about these two terms that "in collaboration, partners do the work 'together,'" whereas "in cooperation, partners split the work, solve sub-tasks individually and then assemble the partial results into the final output" (1999, p. 11).

Bernard et al. (2000) discussed some issues for the collaborative learning practice: (1) it was important to know the target population as well as possible before designing virtual learning environments. (2) A positive social environment was very essential to promote the collaboration (Palloff & Pratt, 1999). (3) Small group size encouraged true collaborative online learning (Branddon & Hollingshead, 1999). In collaborative learning, students worked together in small groups to complete projects by questioning each other, and discussing and sharing information (Le, 2001). Thus, the students were responsible for one another's learning as well as their own. The success of one student helped other students to be successful. (4) Debate and projects were two constructivist approaches for collaborative learning (Bernard et al., 2000, p. 269). And (5) instructional designers and educators should integrate the vast computer-based communication technologies to promote collaborative online learning (Palloff & Pratt, 1999) such as: *WebCT, BlackBoard, FirstClass and BSCW (Basic Support for Collaborative Work).* Another researcher, Le (2001), conducted a case study to examine how the Web could be used in collaborative learning. One hundred eighty students were required to recommend at least four websites that

were relevant to the unit contents. The purpose was to encourage students to participate in a community of learners to share their idea and resources. Then the researcher explored how students made use of the available resources in their own learning by examining systematically how often students made reference to the reading materials. The results indicated that students did make use of the web-based readings suggested by their peers in the unit. In fact, collaborative learning fostered the development of critical thinking through discussion, clarification of ideas, and evaluation of others' ideas and also encouraged students take responsibility for their own learning (Gokhale, 1995; Totten, 1991; Johnson, 1986).

Morris et al. (1997) concluded, "Group activities are considered to develop transferable skills, communication and interpersonal skills, and to enhance deep learning, leading to improved learning outcomes" (p. 67). Based on past research, due to the consideration of volume of messages, using small groups for collaborative online work was common and more workable. Small groups were formed so that people with different relevant skills were brought together to work out a solution to the problem (McAlpine, 2000). Since group work was such an important factor in the collaborative learning setting, the emphasis was placed on the interactions as common understandings were negotiated and developed across differences of knowledge, skills and attitudes. The research indicated that interactivity did not necessarily produce gain in user learning, but it positively influenced participants' attitudes (Haseman et al., 2002). Moreover, all the participants in the collaborative group must be aware that sharing their thoughts and knowledge was not just important but essential, and offering a rational challenge to the ideas of others was an essential contribution to the discussion (Dawes & Sams, 2004, p.98).

Guanwardena, Lowe and Anderson (1997) emphasized that even when a discussion consisted in a large part of replies instead of only new messages, the connection between

different messages still could be lacking. This often resulted in newly added knowledge that just kept "floating" on its own, without being further refined or elaborated upon. The highest forms of 'constructive' or 'knowledge sharing' activities still seemed to be lacking. Diaz and Cartnal (1999) believed that though online students preferred independent learning situations, they were willing and able to participate in collaborative work if they had a structure from the teacher that would initiate it. Lage, Platt, and Treglia, (2000) found that women preferred opportunities to relate material to their own lives. Women were more comfortable working in collaborative environments than competitive environments, and they were more successful and more persistent when they were comfortable.

Summary

Since the late 1970s there has been an increased focus on the applicability of learning styles research for learners in a range of educational settings. Instructional design decision-making has been switched from the focus on the learning outcomes, to the motivational and cognitive views of learning from the learner's perspective. Learning styles research has provided a wealth of insight into individual differences and orientations to learning that could be translated into instructional design (McLoughlin, 1999). Meanwhile, with the increasing development of distance education, more significant research dealing with variables that affect distance learners now demands the attention of educators (McIsaac and Gunawardena, 2003). Increasing development of the computer-supported collaborative learning requires attention from all researchers and educators interested in online learning.

Shale (1990) called for an examination of communication technologies as part of education at a distance when "teacher and student physically separated" (p. 334). A few recent studies have attempted to examine learning style variables and media and methods use in distance education.

Verduin and Clark (1991) examined learning styles within the distance education setting and indicated that learning style information could be helpful to educators in planning courses. They further concluded that adults might or might not learn more easily when the style of presentation matched the students' learning style, but when the two did match, students reported being more satisfied with the course. Whether students with different learning styles had different participation behaviors was the interest in this study.

For the purpose of the current study, a widely used model of the learning style instrument was administered as the basis information. Kolb's theory of experiential learning (Kolb, 1984) was used as a staring point because of its "consistency with stages of cognitive growth and development" (McLoughlin, 1999). The core of the theory is that learners develop through a learning cycle in which experience leads to observation and reflection, which then leads to concept formation. Kolb's LSI, developed from this theory, has been adopted for the present study because it has been found to be successfully implemented in adult learning contexts (Kolb, 1984). The detailed methodology of this current study is described in the next chapter.

CHAPTER THREE: METHODOLOGY

Introduction

The purpose of this study is to explore the participatory and collaboration behaviors of students with different learning styles in a text-based online leaning environment. All aspects of the research methodology used in this study are reported in this chapter. The information is organized into the following sections: (1) research questions, (2) research site, (3) participants, (4) setting, (5) research design, (6) data collection methods, (7) trustworthiness of the research, and (8) the pilot study.

The purpose of the course *Learning Technologies* chosen for this case study was to help students understand various roles that computers might take in a learning setting, and guided to explore ways of integrating technology into the classroom. What students learned and how students learned in this course were indicated from student discussion and performance in the online collaborative learning environment, not simply from the final course grade. I observed and analyzed students' performance behavior in terms of learning styles rather than looking simply at achievement for a cause-effect relationship between learning styles and course grade.

This study examined the possible role of learning styles in the online collaborative learning environment. To achieve these purposes, this case study research was conducted through a content analysis of students' discussion posts in an online text-based Computer-Mediated Communication (CMC) course offered in one large Midwest University.

Research Questions

My overarching research question is:

> How do groups made up of different combinations of learning styles engage in collaborative learning and what is the nature of the engagement?

I also pose several sub-questions, or related avenues of exploration:

- What role do individual learning styles play in individuals' online collaboration behaviors?
- Is the preferred learning style actually used in online discussion and collaboration even when another learning style might be more effective, or do students use less preferred but more effective learning styles?
- Do some combinations of learning styles in a collaborative group seem to support collaboration better than other combinations?

Research Site

The *case* in this study was a Web-based course offered through the Blackboard Course Management System (CMS) in a college of education, a course entitled *Learning Technologies*. This course was a prerequisite for a graduate specialization in Educational Computing (masters and doctoral level), one option to meet a technology requirement in the Curriculum & Instruction (C&I) masters degree program, and an advanced undergraduate requirement for Computer Studies. It also met the technology course requirement for all specializations within the masters' degree in C & I. The primary audience for this course was teachers of students of K-16 and higher, but it also targeted beginners in educational computing. In-service teachers and educators (and some pre-service teachers) in this course encountered modern points of view about using technologies to improve learning and understanding in the classroom or online setting. Students were required to participate in three collaborative projects which represented the bulk of their coursework.

There were several reasons to choose the *Learning Technologies* course for this study: firstly, most students in this course were in-service teachers who wanted to attain a higher degree of

technological literacy for their teaching. As adult students, they also took responsibility for their teaching beyond this classroom and they brought their own experiences and understandings to the classroom to share with each other. Due to their high motivation, I expected to collect rich data from their communications during the class. Secondly, the course delivery format was a perfect match to my study design. The course was delivered totally online and the students formed several groups to conduct their collaborative group projects. Thirdly, I had had opportunity to informally observe how students participated in this particular course during the previous school year as a teaching assistant. Based on these observations, I found that some groups conducted very efficient discussions but some did not. What factors played a role in these interactive activities? Does the course design enhance computer-mediated communication? What needs to be improved in terms of instructional design? In order to learn more about the success of some groups and lack of success in others, I chose to conduct my research in this same course.

The Reasons for choosing Kolb's Learning Style Inventory

Dunn (1981) points out that even the researchers have different points of view concerning Learning Styles Theory. For example, Kolb suggests that learning style is inherited while the Dunns indicate no relationship between the styles of children and their parents or siblings. Gregorc and other researchers suggest teaching starts from the weaker characteristics of the students; however, the Dunns insist that students should always be taught through their strengths (Dunn 1981, p. 272). After carrying out the literature review, I have chosen Kolb's LSI for use in this study for the following reasons:

- The purpose of the study is to explore students' collaborative learning behaviors by analyzing their ways of perceiving, thinking, and problem solving. Regarded as one belonging to the *cognitive learning style* mode (James and Gardner, 1995 p.20), Kolb's

LSI is a good instrument to use for this study. The four learning styles illustrate solving problems (Convergent), identifying information and values (Divergent), thinking sequentially (Assimilation), and carrying out the plan quickly (Accommodative).

- Different research methodologies may help explore learning style theory in the context of the online collaborative learning environment. Among the few studies about learning styles and online collaborative learning, Wang et al. (2001) administered Kolb's LSI in a quantitative research by comparing the average achievement score of different learning styles groups. The findings indicated that there was no significant difference among the groups. However, the achievement score might not accurately reflect learning effects in collaborative learning. I believe case study research is necessary to examine the students' collaborative skills in order to see what is happening and to understand the processes better.
- Students in *Learning Technologies* bring their own teaching or learning experiences to the discussion board, share their positive attitudes, help each other solve problems, and create a very practical learning environment. The projects we conducted in the class could be used in students' real teaching life too. Developed from his ELT, Kolb's LSI was used in the current study because it has found to be successfully implemented in adult learning contexts where experiential learning is an appropriate pedagogy.
- According to Kolb, his experiential learning model was able to differentiate between traditional and nontraditional student populations. Keri (2003) suggested that future studies interested in assessing whether learning style differences existed across age levels might need to consider using the frequently tested instruments such as Kolb's LSI with

adult populations. Although it was not my intent to compare traditional and nontraditional students, I believe that Kolb's LSI was best suited for this study.

- Unlike many psychometric tests, Kolb's LSI is simple and quick to complete (10-15 minutes). It's just 12 questions on which the users are required to rank themselves. In order to guarantee the return of the survey, I administered the inventory to the participants at the orientation session, and the participants finished it very quickly and gave it back.
- After filling out a research application form and conditional use agreement, I received permission from the Hay Group to use the Learning Style Inventory at no cost. At the same time, the Hay Group also provides the profile sheet which contains the answer key for the test as well as the profiling graphs for plotting scores. The support from the Hay Group is meaningful.
- Kolb's Learning Style Inventories has been and still is one of the most widely utilized instruments in past and current research.

Participants

The study participants were students enrolled in the course in the fall semester of 2005. I was also a non-participant observer during the semester; my only direct or indirect contact with participants involved two face-to-face meetings. I attended the kick-off meeting and held a workshop for those who needed help in learning how to make web pages. The study focused on the collaborative group activities of the students in the five groups formed from 18 students who were from the different cities and towns in the Midwest area. In the College of Education, females are the majority in most courses; similarly, in the *Learning Technologies* course, there were only three males in the whole class, also 66% of the students were in-service teachers who

were pursuing their Masters degree in education. There was only one international student (doctoral) and her native language was not English. All the other students spoke English as their native language.

All students had university or personal email accounts required for communication, the ability to access web resources, and the hardware and software necessary for completing the course's web-based assignments. During the first 2 weeks of the semester, students were required to form into groups of 3-4 students based on their technology experiences, location and subject-area interests. Thus the groups were self-selected. Students were able to find out about the experience, interests, and backgrounds of others in the course from the orientation meeting and from the first online activity (see Setting below). These factors and where students lived and worked were typical factors on which they based their group selection decisions.

Setting

The course was delivered online. Students came to campus for an orientation session the first week of class and the rest of the course was conducted entirely via distance education in the online environment, except for one optional lab to learn how to create web pages. Students and instructor met face-to-face only once during the whole semester. The first meeting at the beginning of the course was to help students get familiar with the Blackboard CMS including course activities and format. Not everyone was able to attend, but those who were absent were provided with handouts containing the same information, and the instructor assisted them (via email) with their initial assignment to post information about themselves. Participating in the web page design workshop was optional. In this workshop, I held a lab section to help students learn basic web page design skills. Students who did not have this skill, or who were not comfortable learning this skill on their own, were encouraged to attend. All the other activities

and communication between students, and between instructor and students, were conducted online through email, discussion board and chatting tools. Students who lived close to each other had the option of meeting face-to-face if needed. In addition, students could make an appointment with the instructor for a face-to-face meeting if necessary.

Blackboard was the course management tool used in *Learning Technologies. The Blackboard Learning System*™ is an industry-leading software application that is used as a platform for distance learning programs to power virtual learning environments and supplement classroom education. Instructors can efficiently manage courses, authorize content, create assignments, and foster collaboration, among other key functions by using the Blackboard Learning System, in order to accomplish objectives related to instruction, communication, and assessment. Some of its key capabilities include

Syllabus Builder:

Provides the ability for instructors to easily create a course syllabus by uploading an existing syllabus or by using the built-in syllabus creation functionality to design and develop their own course syllabus and lesson plans.

Learning Units:

Allows instructors to create sequenced lessons and control whether students must progress through the Learning Unit according to the sequence or have the ability to select individual lessons from the table of contents. Students can save their place in a Learning Unit and return later.

Discussion Board:

The Discussion Board enables threaded, asynchronous discussions. Instructors can set up multiple forums around different topics and embed those forums in appropriate content

areas or lessons. Instructors can determine whether students can modify, delete, post anonymously, include attachments, and other options. Forums can be sorted and viewed by thread, author, date, or subject and are completely searchable. This is the section students used most of time.

Virtual Classroom / Collaboration Tool:

The Collaboration Tool, designed for live, synchronous interaction, supports a text-based Chat environment, as well as a full Virtual Classroom. Instructors can schedule collaboration sessions using either environment. In addition to text-based chat, the Virtual Classroom provides a collaborative whiteboard, group web browsing (web touring), private question-and-answer, and breakout room capability. It can be run in a Lecture Mode or an Open Participation Mode. Users can "raise their hand" to be called on or given full participation control. All chat sessions can be logged and archived.

Group Projects:

To support peer collaboration, instructors can use the Groups tool to form multiple groups of students. Each group can be given its own file exchange area, Discussion Board, Virtual Classroom and a Group Email tool to send messages to all group members. Students can belong to multiple groups simultaneously, so an instructor might assign different groups for different assignments or projects. This is the section all the group work has been conducted. (Blackboard Inc., 2005, p. 3)

Research Design

In order to understand a phenomenon, reveal the meaning of the situation, or explain a process (how things happen), a descriptive case study is most appropriate because the researcher generally interprets phenomena with detail that provides in-depth insights into participants'

experiences (Creswell, 1998; Patton, 1990; Marshall and Rossman, 1995; Merriam and Associates, 2002). Strauss and Corbin (1990) further claimed that case study could be used to better understand any phenomenon about which little was yet known.

This research was a descriptive case study as defined by Yin (1994), who believed that such methods were to be used when "a 'how' or 'why' question was being asked about a contemporary set of events over which the investigator had little or no control" (p. 9). Lincoln and Guba (1985), also proposed that the goal of a case study was to develop a "thick description," or a thorough, complete understanding of the case, to help others understand the context. When analyzing the students' participation behavior, it was risky to evaluate students by simply counting their hits or posts made in the class. The quality of student posts was more valuable than the quantity (Simpson & Du, 2004). Due to the nature of the research questions, time, setting of boundaries, and desired purpose of the research, the research was largely case study in nature, with a focus on thick description of context, use of some instruments also enabled the collection of categorical data.. The possible role of learning styles in students' collaborative behaviors was explored based on a content analysis of class observation and discussion postings. The research then examined learners' attitudes toward the project, nature and quality of projects and of discussion, and other factors that emerged in observations and analysis.

In order to establish the quality of the quantitative research, Yin (1994) discussed three procedures to increase construct validity and reliability: 1) multiple sources of evidence, 2) a case study database and 3) a chain of evidence (p. 78). These procedures can also be implemented in case study research. Also, according to Yin (1994), multiple sources of evidence are "the development of converging lines of inquiry, a process of triangulation…" (p. 92). In this

study, the data were collected from participant-observation field notes, the Learning Styles Instrument, learners' discussion posts, and learners' project reflections.

Based on the second principle of creating a case study database, two tables were developed for the student group under investigation. During this process, each project was categorized into two charts (see Table 1 and Table 5). This consistent approach allowed me to present sufficient evidence and thus also increased the dependability and confirmability of the study. In addition, I took case study notes during the course of the study in order to keep a record of my observations.

Data Collection Methods

Observation

I was a non-participant observer during the class. At the beginning of the class, I attended the face-to-face orientation meeting to ask for the students' permission to collect data and to access Blackboard to observe students' online interactions for the duration of the course. Also, at the beginning of the semester after having students fill out consent forms for this research, I administered *David Kolb's Learning Styles Inventory* (Kolb, 1999) to all the students who volunteered to participate in the research, and asked them to do a self-evaluation of their own learning styles at the beginning of the course. Kolb's Learning Style Inventory consists of 12 self-description questions. Each item asks the respondent to rank-order four words in a way that best describes his or her learning style (Kolb, 1984, p. 68).

According to the Institutional Review Board (IRB), the researcher must obtain permission to collect students' archived discussion posts, project reports and reflections, and archived online chat records. Student consent forms were handed out and signed before any data were collected. Course requirements, guidelines, grading rubrics and project assignments were collected with the

permission of the instructor. Students' icebreaker assignment in which they posted an introductory message about their background was used to generate participants' demographic information. Students were required to submit a reflection after each project. This reflection was the primary source used to determine student attitudes toward the course and group work.

Data Analysis

Blackboard, like many Web-based discussion board programs automatically records users' activities by tracking usage statistics for those who sign on (Ingram, 1999/2000). Individual student participation could be evaluated by determining the number of the messages or length of time online. However, these data are incomplete because login frequency and time spent online do not necessarily indicate participation levels.

Silverman (1993), in his book *Interpreting Qualitative Data* pointed out that content analysis was an accepted method of studying text documents in communication because all the discussion data were analyzed as a whole, which resulted in less reliance on the researchers' subjective impressions. This method required generating categories, coding the content and generating frequency counts for each category.

The coding system for content analysis was constructed after analysis of discussion transcripts from the pilot study (to be described in further detail in the following section). A case study database was created based on the characteristics of four learning styles (see Table 1). That is, the words and phrases representations of behaviors of each learning style were used as a foundation for the coding schemes. The students' discussion posts were coded into these content categories.

The process of coding was basically one of selective reduction. By reducing the text to categories consisting of words, string of words and/or phrases, from student discussion posts, I

focused upon specific words or patterns that were related to each learning style and the research questions (see Table 1).

Table 1. *The Categories of Learning Styles' Coding*

Styles	**Terms**	**Conceptualization**	**Example**
Convergent	Problem solving	Always come up with the solution for the issue to help	Here's what I think…/ My solution
	Decision making	Using a lot of imperative sentences and assertive tones; the proposal always leads to the action.	Let's do it./ Let's go with it./ I think we should…/
	Practical application of ideas	Propose the doable plan and suggestion	I don't think it matters all that much. If one fits the spacing, then use it. If not, then don't worry about it. Just make it look appealing… that matters more than the number of pictures. If…then…/
	Logical / systematical thinking	Give clear explanation of how to do it step by step	First…second…/ The important thing is we have all our ideas together…right now, all we need to do is put the pieces together. / I think…/ it would be different…/
	Analyzing idea	Always provide the reasons to back up the idea clearly instead of just throw out the idea	The reason is…; because…; I would say…because../ I like that since…/ that's why…/
Divergent	Adaptive ability	View concrete situation from many perspectives and organize many relationships into a meaningful "gestalt."	In conclusion … / after considering the issue of …, we could say…
	"Brainstorming" ability	Quickly bring up ideas, very imaginative and creative	How about…/ There are just a few ideas./
	Social / interpersonal	Relating to people, maintain the discussion flow, give the feedback quickly, show the consideration to the others' situation, and give positive comments	Good idea! / I see, / good point./ okay,/ thank you / I understand…/ I know what you mean…/ this looks awesome/
	Feeling oriented	Follow the feeling during the process and reflective understanding	I feel…/ I'm sure we are doing fine, if not I'd be going nuts, but I'm not. / I especially like…/ I'm sure…

	Patient, impartial, considered, thoughtful judgment	Very calm and seldom show upset, ask for the evaluation from external resources,	I like this intro, it's simple for kids to digest and understand what they are supposed to do." / Calm down,…/ to be honest, / I don't think…/
Assimilating	Create theoretical models		The thing they will learn from this particular experience is how to use knowledge…to figure out how to pick up…
	Assimilating disparate observation into an integrated explanation	Considering the issues from different perspectives,	If we can kill two birds with one stone, why not? As well as…/
	Being realistic	Concern with what is true or how things happened rather than what will work	In real life, / my own experiences show
	Concerned with ideas and abstract concepts		We should consider the concept like…/ according to the theory,
Accommodating	Rely heavily on other people for information rather than on their own analytic ability		What do you think about…? / Do you have some idea…? What we should do…? Can we…? Is this okay…? I need your information…/ Do I need…? I came up with the idea after looking at a few other webquests to determine exactly what we really needed for the task page
	Impatient and 'pushy'	Use lots of exclamatory marks, easily upset and worry about the progress	I'm starting to really freak out about this thing that we won't have it completed in time. / Hellllllpppppppppp!!!!!!
	Solve problem in an intuitive trial-and-error manner		I decide not to use the arrow, it just got too confusing. / it probably be pretty easy to come up with./ I wanted to have…
	Likely discard the plan or theory, quickly adapt oneself to changing environment	Change the idea very quickly	Should we change? / I'm going to rework…/ I change the idea not to insert the pictures
	Doing things, carrying out plans	Good at getting things done	I'm working on it./ I will try to get it down by…/

	Emphasize practical applications as opposed to reflective understanding		Give me exactly words… / how are we exactly wording…/ I want to know exactly what we want…?let me know…?
	Being flexible		I'm up to everything../ I'm okay with it…/ I'm quite flexible…/

Students' discussion posts numbers from different projects were grouped into themes in order to look for developing patterns in the data (see Table 2)**.**

Table 2. *Numbers of Discussion Posts from Students*

Styles	**Terms**	**Student A**	**Student B**	**Student C**	**Total**
Convergent	Problem solving				
	Decision making				
	Practical application of ideas				
	Logical / systematical thinking				
	Analyzing idea				
Divergent	Adaptive ability				
	Brainstorming ability				
	Social / interpersonal				
	Feeling oriented				
	Patient, impartial, considered, thoughtful judgment				
Assimilating	Create theoretical models				
	Assimilating disparate observation into an integrated explanation				
	Being realistic				
	Concerned with ideas and abstract concepts				
Accommodating	Emphasize practical applications as opposed to reflective understanding				
	Rely heavily on other people for information rather than on their own analytic ability				
	Impatient and 'pushy'				
	Solve problem in an intuitive trail-and-error manner				

	Likely discard the plan or theory, quickly adapt oneself to changing environment				
	Being flexible				
	Doing things, carrying out plans				

David Kolb's Learning Style Inventory (LSI) (Kolb, 1999) was first administered during the beginning of the class but this self-evaluation of learning styles was put aside before the analysis of students' discussion postings in order to avoid unintentional bias in coding. Kolb's profile sheet that contained the answer key for the instrument as well as the profiling graphs for plotting scores was used to generate students' learning styles from their own self-assessments. I compared those coding results and LSI results and analyzed the implications of the results to answer the research questions.

Trustworthiness of the Research

There is a need to consider about validity and reliability in case study research. Whether the study is quantitative or case study, the reader reviewing the study wants to know if the study was conducted in a thorough manner and if the results could be trusted (Merriam & Associates, 2002). Therefore, the basic question regarding trustworthiness in a case study is: How can the researcher persuade his or her audiences that the findings of the study are worth taking account of (Lincoln & Guba, 1985; Merriam and Associates, 2002)?

In a broader sense, trustworthy needs to be based on the use of 'acceptable' research procedures to systematically collect data, and allowing the procedures and findings to be open to the critical analysis from others. Lincoln and Guba, (1985) asserted that four criteria, "Credibility," "Transferability," "Dependability," and "Confirmability" have been used to

convey trustworthiness, which are equivalent for the conventional terms “Internal Validity,” “External Validity,” “Reliability,” and “Objectivity” (Lincoln and Guba, 1985; Trochim, 2005).

Credibility

Credibility refers to how truthful particular findings are and is dependent upon the richness of the information gathered and on the analytical abilities of the researcher (Patton, 1990; Lincoln & Guba, 1985; Merriam & Associates, 2002). Detailed description of procedures followed will increase credibility. In this study, text-based discussion posts were frequently examined and compared for accuracy, and also students’ project reflections were reviewed to determine their collaboration behaviors beyond the class in order to guarantee the richness of the information gathered. Furthermore, I met with my major professor, who was also the course instructor, to discuss the study and verify the data analysis process, and the accuracy of the data presentation and logic of the findings, implications, and research recommendations.

Dependability and Confirmability

Dependability or reliability refers to the consistency and replicability of the study. According to Trochim (2005), the traditional view of reliability is based on the assumption of replicability or repeatability. Merriam and Associates (2002) also emphasize that “Replication of a qualitative study will not yield the same results, there can be numerous interpretations of the same data…the important question for qualitative researchers is whether the results are consistent with the data collected” (p. 27). The idea of Dependability emphasizes the need for the researcher to account for the ever-changing context within which research occurs. The researcher is responsible for describing the changes that occur in the setting and how these changes affected the way the researcher approached the study. Confirmability or objectivity

refers to how neutral the findings are in terms of how reflective they are of the subjects and of the inquiry and not a product of the researcher's biases and prejudices (Merriam & Associates, 2002).

According to Lincoln and Guba (1985), both Dependability and Confirmability can be determined through a properly managed case study database charts for data collection and data analysis so that others could conduct a similar inquiry. Besides, peer review could help increase the confirmability. To ensure Dependability and Confirmability, accurate files were maintained, including: the researcher's journal, the students' discussion postings, students' self-evaluation Learning Style Inventory, students' course reflections, materials from the data analysis process, and the researcher's field notes.

Transferability

Stake (1995) writes, "The real business of case study is particularization, not generalization. We take a particular case and come to know it well, not primarily as to how different it is from others but what it is, and what it does" (p. 8). From a case study perspective, transferability is primarily the responsibility of the reader doing the generalizing. The presentation of 'solid descriptive data' or 'thick description' improves transferability (Patton, 1990, p. 375). The transferability from one study to other situations is also dependent upon the degree of similarity between the original situation and the situation to which it is will be transferred too. The researcher cannot specify the transferability of findings. He or she can only provide sufficient information that can be used by someone else to help determine whether the findings are transferable to the new situation (Lincoln & Guba, 1985). A thorough job of describing the research context and the assumptions has been used extensively in the presentation of data to enable readers of the study to determine if transferability to their own situation is practicable.

The person who wishes to 'transfer' the results to a different context is then responsible for making the judgment of how sensible the transfer is (Trochim, 2005).

The Protection of Human Rights

This research complied with all of the requirements established by the Midwestern Land Grant University's Committee on Research Involving Human Subjects. The University Informed Consent Form (see Appendix G) was sent to each participant to ask their permission for accessing the data. Participants were asked to sign the Informed Consent Form after they had been given the opportunity to ask any questions they had about their rights as participants.

Pilot Study

The pilot study was conducted during the fall semester in 2004 in order to improve upon the methodology and further investigate the credibility of initial coding categories for case study analysis. Based on the research questions of how students' learning styles affected online collaborative learning, the data consisted of 206 threaded discussion posts that were generated from a group consisting of only three members. The researcher analyzed an online discussion of this group working on a collaborative project that spanned 2 weeks.

Pilot Study Data Collection

Students' discussion posts

Each student's discussion posts were categorized according to the features of the four learning styles (Divergent, Accommodating, Convergent, and Assimilating). The posts were analyzed from the words students used, the implied tone of words used in postings and the interactive behavior. The results showed that the three students had very different learning style preferences.

Table 3. *Numbers of Discussion Posts from 3 Students*

Styles	**Terms**	**Student A**	**Student B**	**Student C**	**Total**
Convergent	Problem solving	4			4
	Decision making	10	4	3	17
	Practical application of ideas	10	4	1	15
	Logical / systematical thinking	14	1		15
	Analyzing idea	10	5		15
Divergent	Adaptive ability		9		9
	Brainstorming ability	4	8	4	16
	Social / interpersonal	27	37	4	68
	Feeling oriented	1	22		24
	Patient, impartial, considered, thoughtful judgment	2	9		11
Assimilating	Create theoretical models		2		2
	Assimilating disparate observation into an integrated explanation		10		10
	Being realistic		5		5
	Concerned with ideas and abstract concepts	1	3		4
Accommodating	Emphasize practical applications as opposed to reflective understanding			10	10
	Rely heavily on other people for information rather than on their own analytic ability		1	15	16
	Impatient and ‘pushy’			18	18
	Solve problem in an intuitive trail-and-error manner			20	20
	Likely discard the plan or theory, quickly adapt oneself to changing environment			5	5
	Being flexible	6	7	5	18
	Doing things, carrying out plans	2	2	15	19

Student A: made most of decisions in the discussion postings. Once a group member had a problem or question, she was the one who proposed a very practical idea to help solve the problem. All of her suggestions included a logical and persuasive analysis, which made her

suggestions very acceptable to the others. Out of 17 decision-making posts, she posted 10 (59%), and provided 10 out of 15 (67%) practical ideas. Systematic thinking helped her to analyze the thought clearly and logically, instead of feeling disoriented. For example:

"WebQuest are great because they're very authentic, but that makes it tough for [to] grade. I think we need…."

Student B: was good at bringing up new ideas with creativity and imagination. She was a very feeling-oriented person, for instance when the other students worried about the project, she said *"We are fine (at least I think so), let me tell ya, I'm always working ahead of time to get things down [done] early. So in my opinion, we're moving right along at a pace…."* Another strength of hers was relating to people. Among 68 social and interpersonal posts, she had 37, or 54%. Her comments and feedback in many instances maintained the discussion flow. Especially, when other members in the group started to get worried about the progress of the project, she was patient, impartial, considerate, and gave thoughtful advice and tried to help the others calm down. Her posts conveyed calmness, no shouting (usually signified by capital letters in writing), no panic, and easily assimilated different observations or perspectives into an integrated explanation (10 out of 10 posts), like a meaningful *'Gestalt'*.

Student C: was the mentor in this project, she was responsible for posting the final product on the main discussion board by the end of the two weeks. She was very good at implementation of plans and accomplishing goals. However, it was easy to tell she was a very impatient and 'pushy' person with the phrases like: "*'My brain is going 100mph', 'I'm wanting to know where the rest of the groups are- to see if we are around them in progress or if we are behind or what? How do you guys think we are progressing honestly?!"* In her posts, she used a lot of exclamatory marks and some posts like *"Hellllppppp!!!!!"* On the other hand, she was not a

decision maker. Relying heavily on other people for information rather than on her own analytic ability, she was the one who asked the most (94%, 15 out of 16) questions like *"what do you think about…?" "Can we do this?" and "I need help. Is there anyone giving me idea[s]?" "Do we want…? Let me know."* And other group members had to say *"calm down, and use your own discretion too."*

The results generated from the discussion posts indicated the students' strengths and preferences. Student A was good at decision making, while student B maintained the discussion flow with creative ideas and thoughtful advice. And student C was good at accomplishing the goal but showed very impatience.

Students' Learning Style Inventory

All three students took Kolb's Learning Style Inventory at the beginning of the semester. The students' self-evaluation results were as follows (see Table 4):

Table 4. *Three Students' LSI Self-Evaluation Results*

	CE	RO	AC	AE	AE-RO	AC-CE
Student A	22	23	**42**	33	10	20
Student B	25	**37**	25	33	-4	0
Student C	33	19	30	**41**	22	-3

The above scores indicated how much each student relied on each of the four different learning modes: student A had the highest score at Abstract Conceptualization (42), and then the second one at Active Experimentation (33), Reflective Observation score was 23 and the lowest one at Concrete Experience (22); student B had the highest score at Reflective Observation (37), Active Experimentation seconded (33), while Concrete Experience score and Abstract Conceptualization score were equal (25); and student C had the highest one at Active

Experimentation (41) and Concrete Experience score was 33, following the Abstract Conceptualization score at 30, Reflective Observation score rated at the lowest at 19.

Next I plotted students' scores on the different Cycle of Learning graph separately so we could see that the connected dots formed different kite shapes. Because each person's learning style was unique, depending on several dimensions of learning preferences, everyone's kite shape was a little different. The learning preferences indicated by the shape of the kite indicated each student's own particular learning style and how much they relied on that style.

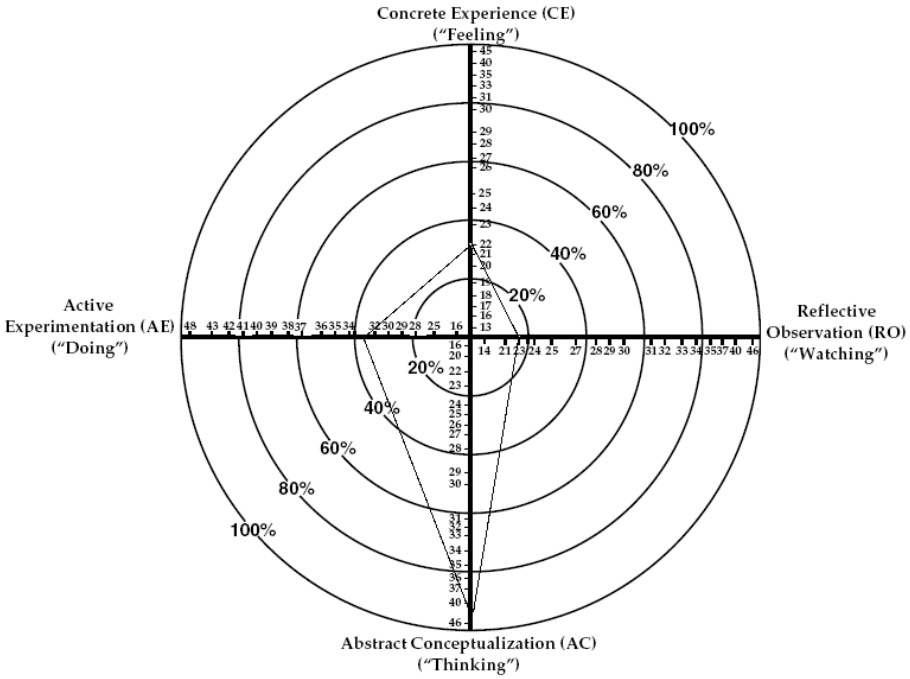

Figure 4. Student A: Kolb's Learning Style Profile.

This kite shape and the ones that follow are created based on students' learning style inventory scores. Permission obtained from Hay Group.

Student A: The LSI showed that her preferred style was the Convergent Learning Style that combines Abstract Conceptualization and Active Experimentation. The person with this learning

style may enjoy gathering information to solve problems and tend to converge on the correct solution (Kolb, 1999, p. 5).

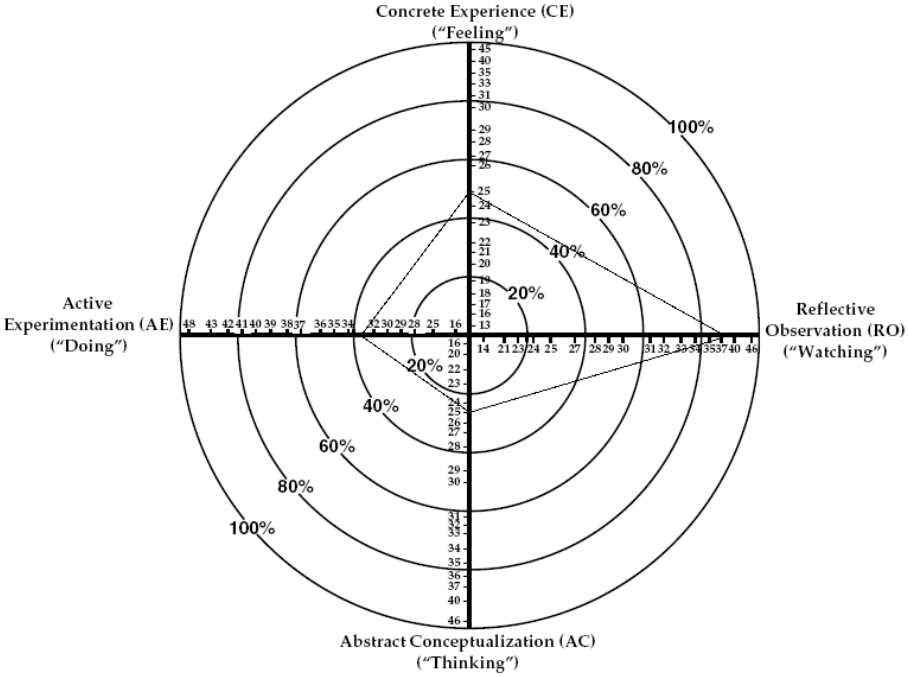

Figure 5. Student B: Kolb's Learning Style Profile.

Student B: LSI results showed that she was self-assessed with a Divergent Learning Style that combines Concrete Experience and Reflective Observation, and Assimilating Learning Style which combines Reflective Observation and Abstract Conceptualization. The person with divergent learning style may consider a situation from differing perspectives, and come up with alternative possibilities (Kolb, 1999), while assimilating person tend to absorb information into theories or models (Kolb, 1999, p. 5).

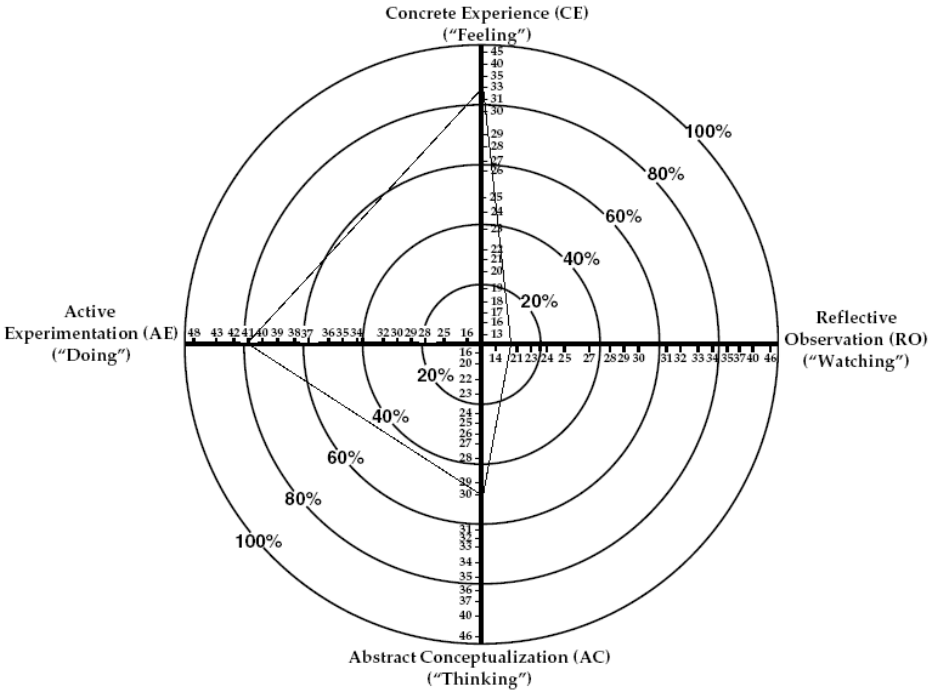

Figure 6. Student C: Kolb's Learning Style Profile.

Student C: results showed that she was self-examined with an Accommodative Learning Style that combines Concrete Experiences and Active Experimentation. The accommodative person wants to put ideas that he has practiced into action, finding still more uses for whatever has been learned and also tends to adapt to changing circumstances and information (Kolb, 1999, p. 5).

While the kite shape demonstrates the relative preferences for the four phases of the learning cycle, the combined scores explain which of the four dominant learning styles best describes the learner. The two combination scores are obtained from two subtractions: AC-CE and AE-RO. The Learning Style Type Grid created by Kolb (1999) provides clear visual understanding for the learning styles. The closer the data point is to the center of the grid, the more balanced the

learning styles. If the data point falls near any of the far corners of the grid, it tends to rely heavily on that particular learning style.

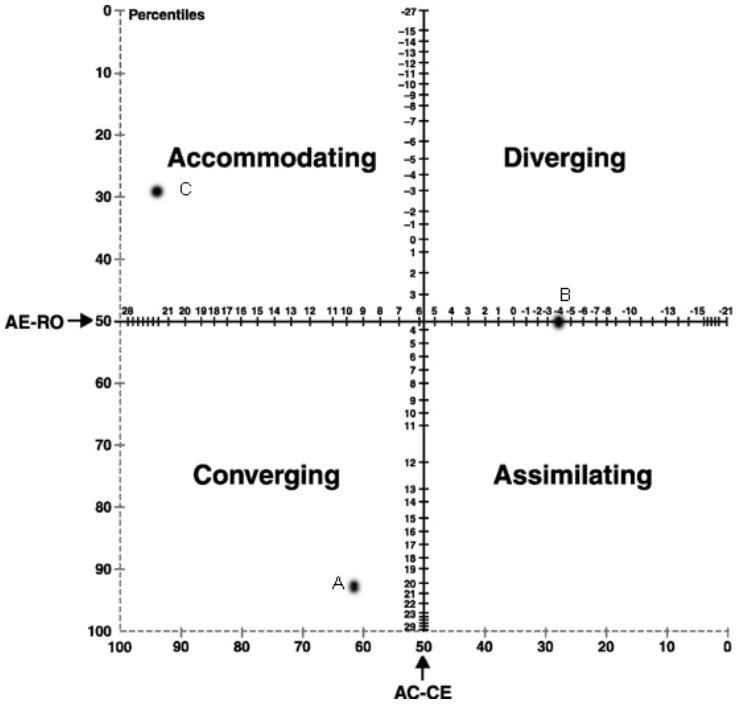

Figure 7. Three Students' Learning Style Type Grid.

Adapted from Kolb's LSI with students' LSI scores. Permission obtained from Hay Group.

From Figure 7, Student A had AC-CE = 20 / AE-RO = 10, the data point closed to the far corner of the grid in Converging quadrant, which meant she had obvious Converging Learning style; Student B had AC-CE = 0 / AE-RO = -4, with the data point located on the line of AE-RO and closed to the center of the grid, which meant she balanced between Diverging learning style and Assimilating learning style; Student C had AC-CE = -3 /AE-RO = 22, with the data point closed to the far corner of the grid in Accommodating quadrant, which indicated that she heavily depended on Accommodating learning style.

Pilot Data Analysis

According to Kolb's definition and description of the four learning styles, the content analysis results from discussion posts showed:

- **Student A** had a Convergent learning style,
- **Student B** had a Divergent learning style and Assimilating learning style;
- **Student C** had an Accommodative learning style.

Students' self-evaluations reinforced the LSI results for student A (convergent learning style– see Figure 4), student B (divergent learning style and assimilating style–see Figure 5) and student C (accommodative learning style–see Figure 6). The results of the LSI matched with the results that I found from the discussion postings.

All three learning styles contributed to get the project done.

1. The student with the convergent learning style was a very good leader and was able to make decisions and problem solve with certainty, logical analysis, and clear thinking.
2. The student with the divergent learning style was very good at brainstorming with imagination, and was very considerate, impartial, and had thoughtful advice. This student also took a lot of initiative in the project although she was not the summarizer at the time. Another of her strengths was cooperation and exchanging ideas throughout the process.
3. The student with accommodative learning style strengths was the implementer of necessary steps needed to get the project done. She adjusted easily to change and arrived at the right answer intuitively.

On the other hand, these three learning styles were not mutually exclusive. Students with very dominant learning preferences had other behaviors, for instance, the student with convergent learning style paid attention to the details and also showed concern in relating to people with 27 postings out of 68 (40%); the student with divergent learning style also showed

the ability for decision making and provided practical ideas (8 postings); and the student with accommodative learning style also brought up very good ideas (4 postings out of 16).

After the pilot study, I created one chart for analyzing students' collaboration behaviors. The coding themes emerged from the discussion postings that represented students' role in the collaborative learning. Table 5 shows the coding examples.

Table 5. *Students' Collaboration Behaviors Coding Scheme*

		Example
Leadership	Decision making	Okay, let's use it.
	Tutoring	Take out the roles completely. Put the grid in and say to choose 3 activities going across, down, or diagonal.
	Explaining assign	Just so you know, The webquest assignment has nothing to do with the making a simple webpage assignment. It's okay that you put your webpage examples here though.
	Organizing	First of all, we will do the elementary since N already started some of it; then I'm just going to randomly assign roles: C1 the affiliator; C2 the efficiency expert, N the Altitudinist, and me the Technophile…
	Initiating project	I'm starting to look over this assignment tonight and tomorrow and will get with everyone this week to decide what to do. I'm learning up this assignment.
	Initiating discussion	Replay here AFTER you step out the role, read all other groups answers, and decide what the best answer is to this question. That is what you will post here.
	Affirming	I like C's idea of health for the final overall discussion. That is such a great example considering we have so many obese children in US.
	Evaluating	I like the rubric on the tripod.com/smoke webquest. It is for a press release but it addresses knowing their position etc. I think we ought to use that although we need to change from individual to group.
	Pushing process	Hey make your overall comments when you have time. I will get the summary done tomorrow.

	Reminding	Just a reminder, I can't keep all of these dates straight, so I thought it might help putting due dates on here!
	Problem solving	The tic tac toe doesn't go with the actual webquest. I thought we could adapt it for this if we wanted. The roles are all different. They should be finding information for smoking and against smoking and drinking and not drinking. I added all that information in so they knew what direction to go.
	Capitalizing	I WILL HAVE THE PAGE UPDATED TONIGHT SOMETIME. THE LINK IS NOT CURRENTLY UPDATED. I HAVE BEEN WORKING ON IT ALL MORNING AND WILL FINISH IT UP SOMETIME TONIGHT.
Support	Offering help	I will summarize if needed.
	Interrogating	I am having a problem. Is the point in this webquest to see the effects of smoking and drinking or to see if the legal age should be changed? Or is it both?
	Responding	Yes, the webpage needs to be spruced up. Great idea!
	Suggesting	The webquest is pretty easy to navigate, and very authentic (something we can mention in the teacher page) but I wonder if we need to "spruce" it up, add some color, so it will catch and hold the kids' attention?
	Asking for help	I am showing my age, I can't remember the site of the web page that C1 designed. Could you remind me where to find it? Thank you.
	Depending on others	Do I need look at somewhere else guys? I am wondering what I should be doing. Help! I'm not for sure!!!!!
	Brainstorming	The other option we could have the students participate in would be an interactive role playing where part of the class has to play the company that makes the cigarette and part of the class could be the insurance companies and we could have them act out the parts those two would play. Also how lobbying would play into this decision, especially if it was to be voted on by the people. These are just some ideas!
	Asking for confirmation	PLEASE look this over and feel free to make suggestions to plan and rubric…we would like to post Friday after school…make sure you let us know if this is really off base!

	What do you think?	I was very confusing and so we thought that we'd get something down on paper and see what you and N thought.
	Providing info	Go to usd305.com website. Go to South High Faculty. Click on PE/Health and it should be titled Smoking and Drinking.
	Focusing on details	The background goes well with the color of the links. The color is a lot more appealing to look at.
Negotiation	Agreeing	The two that you said were the worst were the two best for me because they were to work in groups and that was a positive for my role. You're right thought that they didn't have any real authentic instructions.
	Disagreeing	Okay, to me it seems like the "roles" and the Tic-Tac-Toe Grid contradict what each other.
	Chit chatting	I think we all need to meet in M town and go out for dinner once this class in over! ☺
	Encouraging	I think our group is doing a great job at keeping each other on task. Isn't that what cooperative learning is? ☺
	Confusing	I'm feeling a little lost. What should I be doing to help out this week, give me some hints.
	Arguing	I just don't see how you do all this research on the effects of smoking and drinking and then relate it to whether the drinking age should be changed. Personally, the research, I HOPE, would convince the kids to not drink or smoke at all not matter the age.
	Worrying	My only concern with the grid was that each block told them to do different directions that what was stated in their individual roles.
	Thanks	Thank you so much for helping out with this project and leading the rest of us through. I really appreciate your help.
	Complaining	By the way, how is everyone doing on their paper? I'm stumped. I hate writing.
	Apologizing	I am sorry that I haven't been helping out. Since I had surgery I have been in slow gear!
Cognition	Demonstrating	The lesson involves a partner. We put that under the lesson description. It is also on our rubric as part of the assessment.
	Analyzing	They both developed activities that revolved around multiple intelligences. That in itself would make the assignment easier for each individual student.

	Reasoning	The #1 option for the student to click on has the link to the company that produces the actual cigarette. The ingredient is a great thing to have them to be able to link too!
	Explaining	The North Carolina Zoo was fun for the kids that they learned directions and reading maps. That's an authentic skill.
	Criticizing	I don't think the lesson plan is very clear about the worksheet (spreadsheet) component…somehow it should be completed and submitted for grading as evidence of learning interior angle and sums.

Limitations of the Pilot Study

Although the pilot study showed that learning styles did play an important role in students' collaborative behaviors, many questions still need to be answered, such as whether learning styles consistently and obviously play a role in students' online learning in different projects or in different groups, or in different combination, and how. In order to explore these questions, I needed to collect additional data and conduct a more complex study.

In addition, I needed to observe more collaborative projects accomplished by groups with different learning style combinations to see whether learning styles really played an important role in the collaborative online learning environment and how. The research reported in the current study was conducted over three projects with five groups throughout and entire semester.

CHAPTER FOUR: CASE STUDY OBSERVATIONS

This chapter reports the findings from the content analysis and students' self-evaluation that were conducted. This information is organized in the following sections: (1) narrative description, (2) LSI results, and (3) group discussion results.

Narrative Description

Class setting:

This class started with a two-hour face-to-face orientation in which students got a brief chance to get to know each other and the instructor. This was the only face-to-face class meeting for the whole semester except for one optional lab on making a web page. All the other activities were conducted online via the Blackboard Discussion Board and emails. In this orientation section, students were given the opportunity to start the "Ice breaker" activity by posting an introductory message introducing themselves to their classmates, and respond to other students' messages. In this way, students got familiar with the Blackboard discussion system. During or shortly after this meeting, students were required to form groups of 3 or 4 persons to accomplish the group activities. Some factors suggested by the instructor that they might consider when forming groups included teaching experience, technology experience, location, and interests. Students formed the five groups before the first group project: Team One, Team Two, Team Three, Team Four, and Team Five.

Group information:

The ID scheme used in this study was Tn = Team and Pn= student.

Team One consisted of four female students T1P1, T1P2, T1P3 and T1P4. Four of them were in-service teachers, pursuing their master's degree in the education field. Group members

did not live in the same place, but they formed as a group based on their technology experience and interests. T1P1 had more advanced experience with technology than the other groups. T1P4 and T1P3 worked in the same building, with the result that they could have lots of face-to-face discussion beyond the online discussion.

Team Two consisted of four female students who lived close to each other. Two of the members, T2P3 and T2P2, worked together in one school district and T2P1 and T2P4 worked together in another district. So essentially two pairs came together to make a team. Many discussions on project work were not posted online when they worked with each other in person. All four of them were in-service teachers who had teaching experience and computer skills almost equally.

Team Three consisted of three female students T3P1, T3P2 and T3P3. T3P3 was the only doctoral student in the whole class and she was also the only international student in the class. Before she came to the States, she had had some teaching experience in her country, but she was not familiar with the U.S. education system. Also, language and technology skills were her concern to accomplish the course successfully. T3P2 was an undergraduate student in business education in her 4^{th} year and worked part-time in the town. T3P1, who lived in an adjacent county, was pursuing her master's degree in educational technology and was the only one in the group who had teaching experience in K-12.

Team Four had four students at the beginning of the course, but one of the members dropped out during the first project without giving any reason. Among three team members, T4P3 and T4P2 had a chance to work together before this course, and T4P1 was the only male in the team and was preparing to teach the following year. T4P2 was teaching during the semester. T4P3 was working as a graduate research assistant in the College of Education.

Team Five consisted of four students T5P1, T5P2, T5P3, and T5P4. T5P1 and T5P2 had some computer experience and online course experience. T5P1 temporarily substituted in a school, but the others were not teaching yet. T5P3 would have his student teaching next year and wished to learn more from this course about the integration of the technology into the classroom. T5P2 was in her junior year in business education. T5P4 was working on the coaching staff of the university football team, and was the only African-American student in the class; he was a master's student in education. This was the only group with a balanced male and female ratio: 2 males and 2 females. Because all the members lived in the same town, this group took advantage of it and met face-to-face more frequently than other groups. Their online discussions were thus not a complete record of their work process.

Projects:

The course requirements consisted of three large collaborative projects, each lasting approximately five weeks, a short individual paper, and a final exam. Each of the three big projects had several sub assignments whose purpose was to help the students prepare to do the main part of the project. Some of these sub assignments were individual assignments, and others were team assignments.

The first project "Tutor project" consisted of 6 parts over a period of 4 weeks. Students were required to read the textbook and several assigned articles and to discuss the assigned questions in first two parts of the project. Then students chose different pieces of software to conduct individual and group software evaluations and developed a lesson plan and plan for software integration into the classroom. The purpose of these two parts of the Tutor project was to help students get familiar with the different types of Computer-Aided-Instruction (CAI) software by locating and evaluating them, and also to understand what CAI software was and

how it could and should be integrated into the classroom at different phases of the learning process. The discussions were mainly conducted within the group, and each group was required to post their discussion summary to the main discussion board so that whole class could read it. In addition to the external related course materials, good project examples from previous classes, a discussion question evaluation rubric and tutor project evaluation rubric were posted in the project assignment page so that students could use these for guiding their work.

The second project "Tutee and WebQuest project" involved reading, discussion, skill development, identification and understanding of what WebQuests do, and collaborative hands-on design of a WebQuest. First, students did an online search using their favorite search tools to define the TUTEE category of educational computing and discuss what types of activities fit into this mode of learning. Each group conducted a group discussion to identify and understand the category of tutee software and how to integrate this kind of software into the classroom. Meanwhile, each student generated an individual new skill goal, set out to learn that skill in any way that was possible for them, and demonstrated their skill development by posting a simple example of their use of the new skill in the form of a file. Then, in order to prepare for the WebQuest project, students were assigned to develop a lesson plan for classroom activity that integrated software or hardware TOOL into an activity in which students operated in TUTEE mode to demonstrate understanding, and to develop an evaluation rubric for the lesson. Each group was required to respond to another assigned group's lesson plan by posting their feedback in the discussion board. Next, after gaining the knowledge of simple web page design, students took different roles to analyze different WebQuest examples so that they could become familiar with this type of technology integration methods. Finally, they had two weeks to create a WebQuest of their own, similar to the example, so that they could gain the hands-on experiences

from both the students' and the teacher's perspective. Peer critique required each student to thoughtfully provide constructive feedback and suggestions for another group's webquest. This project's purpose was described in the Syllabus this way:

> The goal of this project is to help students learn how to design the curriculum with rich content in an authentic learning environment by finding the ways to integrate the internet and other communication and productivity tools into the curriculum and see how this is different from integrating tutor software. The purpose of the QUEST project is to explore the constructivist learning approach with an Internet-based classroom activity. The main focus of this approach is to integrate the principles of constructivism to get learners involved in activities which are meaningful to them, to come to understand (not just find) content-related material, to take greater responsibility for their own learning, and to learn technology skills while they are doing it.(Syllabus)

During the second project, I offered one optional web page design workshop to teach those students who thought they needed help with this skill. The 2-hour workshop was held on campus. There were four students who showed up and they reported that it turned out to be very helpful.

The third project "PBL and cognitive tools" started with the requirement to use synchronous communication via Blackboard's lightweight chat room or other instant messenger tools. The purpose of the project was to explore the constructivist learning approach with a Project-Based Learning (PBL) activity. This small PBL project would help students understand an authentic learning environment that encouraged higher order thinking. The most challenging part of this project was that each group of students was responsible for researching one of five constructivist approaches, guided by the driving questions given by the instructor, and they had to understand their project well enough to explain it to other groups and to answer their questions about it. The instructor emphasized the responsibilities in the assignment:

> You will each have to take this assignment very seriously, because what you teach the other four groups will, along with the textbook, be other students' only source of understanding for points of view that they did not research. The final exam, then, will consist of 5 essay questions, one on each approach. Each of you will be responsible on

> the final exam to answer the 4 essay questions from the approach that you did not research.

Students were required to put together a technology project or "artifact" that would teach the other four groups about that approach to the teaching/learning with technology. Those five constructivist approaches were: multimedia projects, knowledge as design, cognitive apprenticeship, constructionism and hypermedia projects. By the end of the project, students were required to make their thinking visible by using one of cognitive tools–iMovie or concept mapping tools–to demonstrate their understanding of readings and the ideas of this unit. Due to the much greater accessibility of and ease of learning concept mapping tools, all the groups chose either *Inspiration* or *Kidspiration* which could be downloaded as a 30-day free trial from the Internet. Each student depended on the work that other groups did because the final exam was based entirely on questions related to other group's concept maps. T3P3 in her journal pointed out that a better project would be one that is well-organized so that the other learners could follow the links easily and understanding the driving questions well, as well as having very good resources.

Project feedback: at the end of each project, students were required to write a project reflection about 1) what they contributed to the project and what other group members contributed; 2) their thoughts on the collaborative process in their own group and suggestions for improving collaboration; and 3) suggestions to the instructor on beneficial aspects and difficulties they encountered while doing this type of online learning to help her modify the course or project design for future classes. In the third project, students were required to keep a personal journal about what they did, how much time it took, what they thought about what they were doing, how the collaboration was going, and anything else that would help the instructor

understand how this project worked for the students and how to improve it. Project feedback and journal were sent to the instructor personally via email so that students would feel comfortable to be critical and make suggestions that might potentially offend their team members or classmates.

My Role as Researcher

Before I came to the United States pursuing my study, I had very few chances to access the computer, not even to mention the Internet. It was impossible to imagine that I could search for information so easily and conveniently from the WWW several years ago. My educational background is in a teacher-centered system in China in which the teachers are the only authority of knowledge, and learning is accomplished through the fact-reciting process. Especially, with intense competition in school, a good grade is the main standard of evaluation. The textbook and the teacher's notes are the main reading materials for preparing for the College Entrance Comprehensive Examination (similar to SAT in the States). How much I still remember of what I learned in this way is a big question now. During my college years, lecture was still the main teaching strategy for most of the courses. I still remember one course I experienced, in which the teacher lectured all the time, and students slept at the corner of the classroom that contained more than 100 students. It was not until the end of my junior year in college that I started to get to know the idea of student-centered teaching and learning and I conducted my research for my undergraduate thesis about it. That was the beginning of a big change in my educational concepts.

In the third project assignment in this case study, the instructor put this in her assignment instruction: "we tend to teach in the way we have always learned." This is very true. I had three years teaching experience at the high school and college level. Although I kept the student-centered conception in mind, and also tried to adapt to it, the difficulty was still there: I worried about whether my students could really learn if I didn't give them detailed instruction; I worried

about whether students could find appropriate or enough learning resources if I didn't give them my own; I even worried about whether they could solve the problem by their own if I didn't give them the answer directly; I worried about whether they could pass those examinations if they spent time on their own learning instead of reciting teachers' notes, and so on. Not only did I worry, also their parents and other colleagues in the department worried. How cam we make sure our students are learning? How can we help students retain what they learned and exploit what they do not know? All these worries and questions became a big challenge and concern in my teaching experience and later in my own learning experiences at the graduate level. I have found that knowledge that I can use in real life or that I have had the opportunity to talk over with others has been kept in my mind after many years.

As a graduate student, my learning experience is quite different from that of my undergraduate days. All of my graduate courses require students' active participation through discussion, presentations, projects, etc. My first difficulty was to become comfortable to speak out my own thoughts, whether agreement or disagreement. It was difficult for me to question what the professor or textbook said. I felt that I did not know enough to think that I had the right to question. Another challenge was the idea that learning could occur in different ways, and everyone could have their own understanding of knowledge rather than everyone having the identical one "correct" solution. Although everyone has different learning preferences in my graduate classes, my colleagues and I still could share and collaborate with each other. Especially after so many years in the same program, we have gotten to know each other very well in person, so even online communication and collaboration via email works well.

As a result of my own experiences and efforts toward changing to a constructivist learning environment, I have come to be more interested in researching how to design an online learning

environment for people with a widely different backgrounds and technology skills, which might or might not include collaborative learning, constructivist learning, multimedia learning, project-based learning and cognitive and cultural issues in Educational Technology.

With this background, I have had a chance to be a teaching assistant in the *Learning Technologies* online course for several semesters. Two professors teaching this course focused on creating a learner-centered collaborative online learning environment. Students with different backgrounds participate in the course via the Blackboard system. I have observed that these students, working in groups, have quite different participation and collaboration behaviors. Some groups seem to have very deep discussions while others do not. Some students enjoy the whole discussion process and feel they learn a lot, even more than in the face-to-face classroom, while others feel frustrated with the whole delivery system. Some students quickly take a leadership role, while some are more supportive. Meanwhile, could the students who hardly met face-to-face, or have never even met each other, share their learning and understanding online as same as people who have met and interacted in person? What might be the reasons that influence these behaviors and what kind of improvements could we make to encourage them actively to participate in collaboration so as to enhance their learning? Furthermore, I still remember that the first semester, I kept asking the professor whether I should answer students' question the first time they raised them even though they had directed these questions to their peers, because I felt an urge to make sure they learned right. The professor encouraged me to stay for a while and let students help each other first. It turned out that students enjoyed very much learning from each other or helping each other, instead from being told by the instructor directly. What is the role of the instructor in the online course? These are questions that brought about my interest in this research project.

Result Reports

Self-evaluation and discussion postings analysis results

At the beginning of the semester, students who volunteered to participate in the research were given the Kolb's Learning Style Inventory (LSI) for their learning style self-evaluation. All students in this class participated. Among 18 participants, one inventory was not correctly filled out, so that result could not be generated.

The following tables and figures showed each team member's learning style self-evaluation findings and my content analysis results from the discussion postings. CE means Concrete Experience; RO means Reflective Observation; AC means Abstract Conceptualization and AE means Active Experimentation. These four learning modes form two continua to help define the learning style of an individual: the learning modes of CE and AC form the opposite ends of a learning continuum to grasp experience and another two modes AE and RO form the other continuum to transform experience. When a learner's preference has been determined on each of these two continua, they fall into one of the four learning quadrants, which reflect a particular learning style: 1) Converging, 2) Diverging, 3) Assimilating, and 4) Accommodating.

Team One

Table 6. *Team One Students' Learning Style Self-Evaluation*

	CE	RO	AC	AE	AE-RO	AC-CE	Styles
T1P1	37	26	30	27	1	-7	Divergent
T1P2	29	34	27	30	-4	-2	Divergent
T1P3	26	35	28	31	-4	2	Divergent
T1P4	30	27	32	31	4	2	Divergent

The above scores indicated how much each student in Team One relied on each of the four different learning modes: student T1P1 had the highest score at Concrete Experience (37), and

then the second one at Abstract Conceptualization (30), Active Experimentation score was 27 and the lowest one at Reflective Observation (26); student T1P2 had the highest score at Reflective Observation (34), Active Experimentation seconded 30, and Concrete Experiences followed at 29, while Abstract Conceptualization scored 27; student T1P3 scored the highest (35) at Reflective Observation and Active Experimentation was 31, following the Abstract Conceptualization score at 28, Concrete Experience score rated at the lowest at 26; student T1P4 had the highest one at Abstract Conceptualization (32), while Active Experimentation closed at 31, and Concrete Experience score rated at 30 and the lowest one at Reflective Observation (27). Comparing students' learning modes, I found that the highest score for T1P1 was also the highest one in terms of Concrete Experience (37>30>29>26) in the group; T1P2 and T1P3 had similar highest scores in Reflective Observation (34 and 35); and T1P4 was mostly balanced among the four learning modes.

Now we can see a plot of students' scores on the cycle of learning graph separately, and we can see that the connected dots formed different kite shapes. The closer the dots are to the 100% ring on the circle, the more there is a tendency to use that way of learning. Because each person's learning style was unique, depending on several dimensions of learning preferences, everyone's kite shape would be expected to be a little different. The kite shape revealed the relative preferences for the four modes of the learning cycle. In the Figure 8, T1P1 intended to use more Concrete Experience mode, while T1P3 and T1P2 used Reflective Observation mode more, and T1P4 equally closed to Concrete Experience and Abstract Conceptualization.

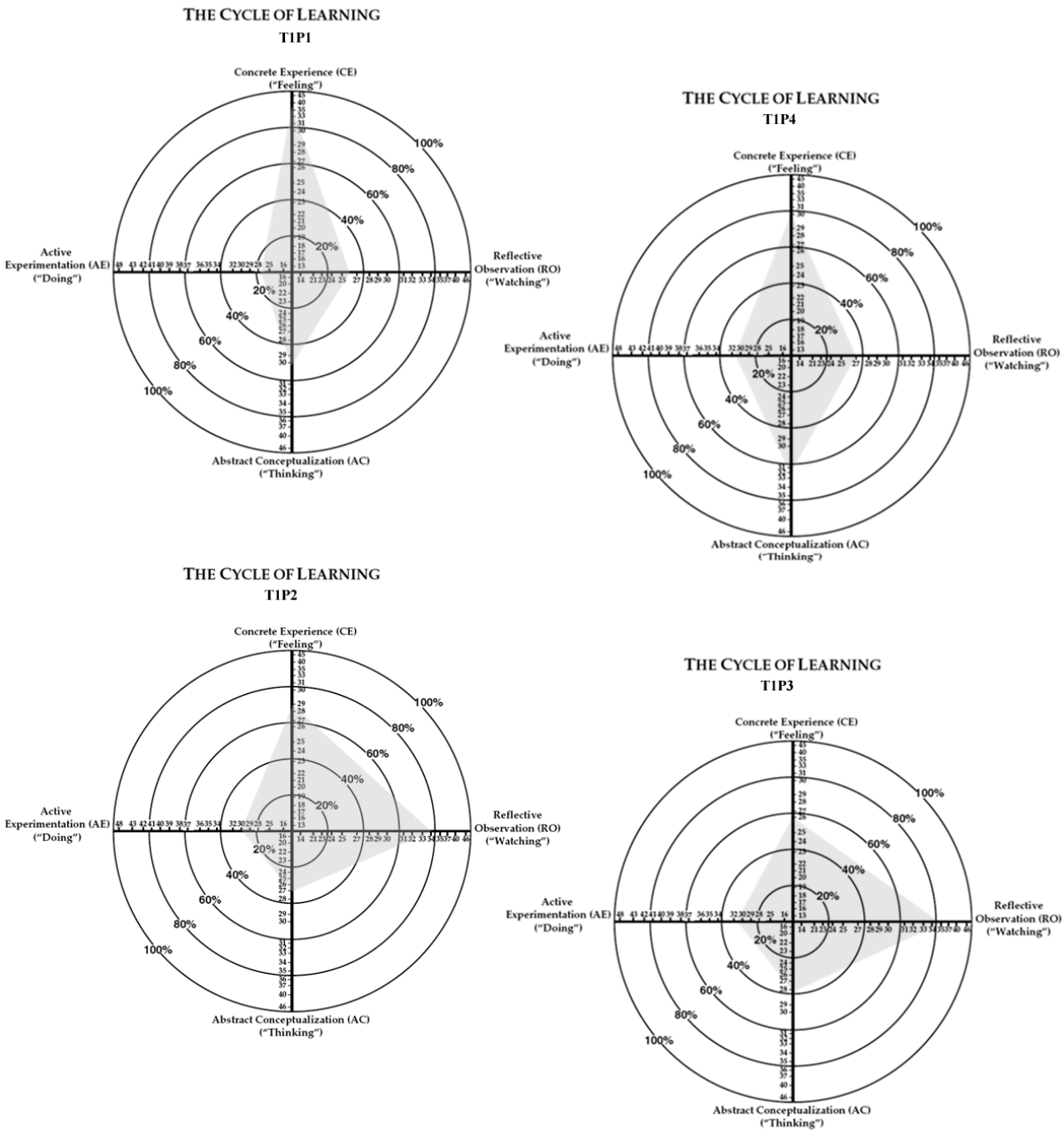

Figure 8. Team One Students' Cycle of Learning Graphs.

The combined scores (AC-CE & AE-RO) in Table 6 illustrated which of the four dominant learning styles best described each student. Plotting each student's score in the

Learning style type grid provided by Kolb (1999), we could see that all four students self-evaluated themselves as having a **Divergent** learning style, which combined Concrete Experience and Reflective Observation. People with this learning style are best at viewing concrete situations from many different points of view. Their approach to situations is to observe rather than take action. They are good at brainstorming, and like to gather information. In the formal learning situations, they prefer working in groups to gather information, listening with an open mind, and receiving personalized feedback (Kolb, 1999, p 7).

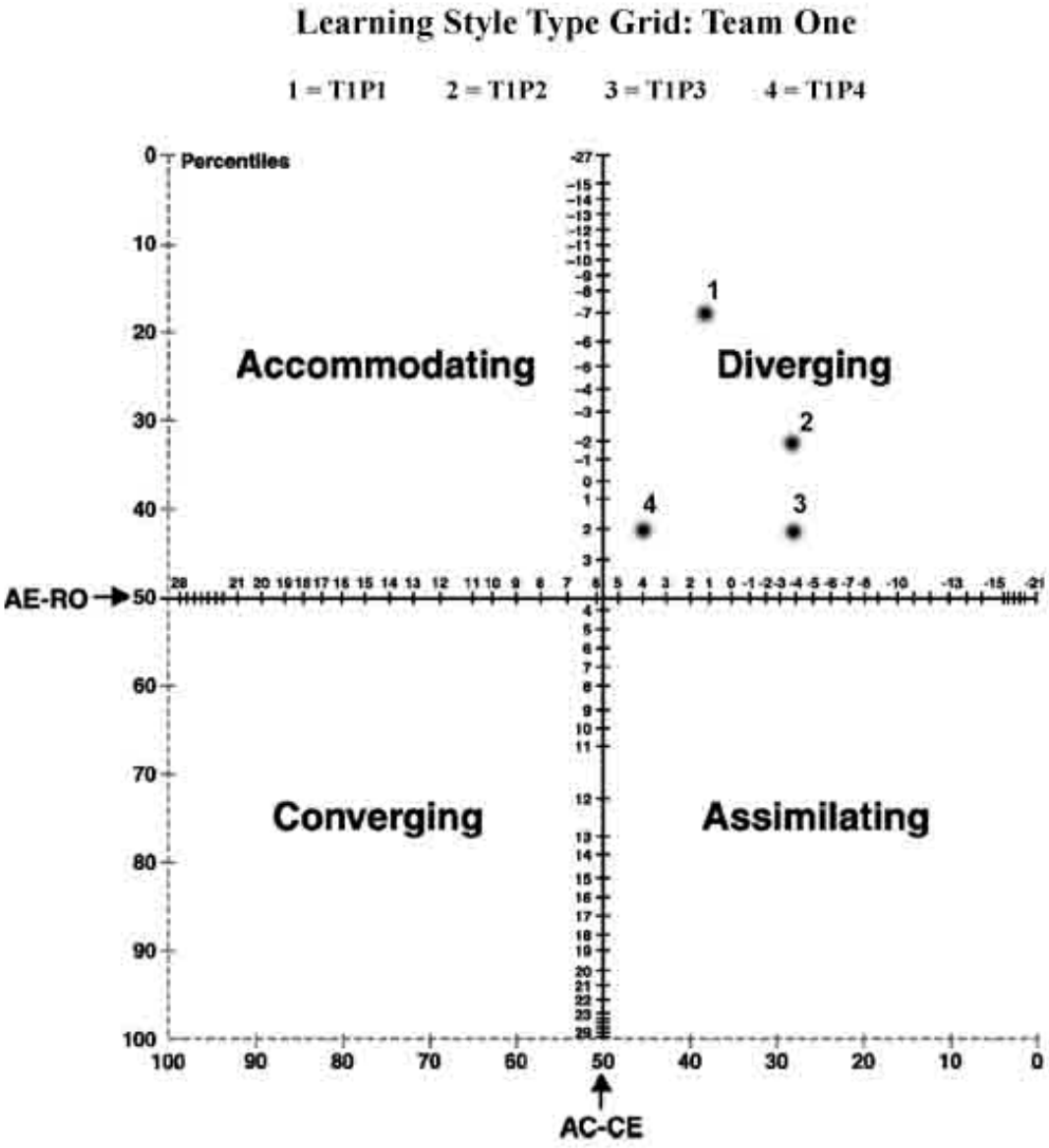

Figure 9. Team One Learning Style Type Grid.

Now we take a look at the results of the content analysis from discussion postings in this group. I conducted the content analysis in two different ways. One was based on the characteristics of the four learning styles (see Appendix B for complete coding of subcategories

for Table 7), and the other was based on the themes emerging from the discussion process considering the collaboration skills (see Appendix A).

Table 7. *Team One Students' Learning Style Content Analysis based on discussion postings*

Learning styles/name	T1P1	T1P2	T1P3	T1P4
Convergent	**87**	21	34	14
Divergent	52	**61**	42	**46**
Assimilating	11	10	13	36
Accommodating	26	**60**	**60**	38

In Table 7, T1P1 had highest score in the Convergent learning style (87) according to analysis of the discussion postings, and a second-highest score in Divergent learning style at 52; T1P3 had the higher score at Accommodating learning style (60) and a second highest in Divergent learning style (42); student T1P2 had her high score at Divergent learning style (61) and Accommodating learning style (60) while T1P4 had the highest score at Divergent learning style (46). These results did not exactly match the students' self-evaluation. The differences will be discussed later.

Table 8 below showed that student T1P1 who had her kite shape close to the Concrete Experience mode, took a strong leadership role in this group by initiating the projects and organizing the collaboration procedures, explaining the assignment and tutoring when the peers were confused, reminding them of the project requirement and deadline to move along the working process, making decisions, etc. Students T1P2 and T1P3 who had their learning preference closed to Reflective Observation, participated in the project in a supportive way through brainstorming, interrogating, suggesting and responding. Student T1P4 who was balanced between Concrete Experience and Abstract Conceptualization also balanced her

participation behavior between leadership through evaluating and explaining assignments and a supportive role through suggesting, interrogating, and responding.

Table 8. Team One Student Collaboration Content Analysis Results

		T1P1	T1P2	T1P3	T1P4
Leadership	Decision making	12	1	2	
	Tutoring	12		3	
	Explaining assign	16	4	5	7
	Organizing	16		2	2
	Initiating project	8	4	3	2
	Evaluating	12	6	8	8
	Pushing process	4	4		1
	Reminding	8	1		3
	Problem solving	8		1	
	Capitalizing	16			1
Support	Offering help	3	4	1	3
	Interrogating	3	4	13	8
	Responding	12	14	13	8
	Suggesting	10	6	14	8
	Asking for help	1	9	3	2
	Depending on others	1	3	7	4
	Brainstorming	3	2	3	3
	Focusing on details	2		1	6
Negotiation	Agreeing	14	13	15	11
	Disagreeing	1	1	2	1
	Chit chatting	4	17	7	5
	Confusing	1	5	5	1
	Argument	4	1	4	5
	Conflict				
	Worrying	1	5	7	4

	Concerning others	6	2	3	2
	Thanks	3	6	4	2
	Complaining	3	1		6
	Apologizing	1	5	3	1
Cognition	Demonstrating	8	13	7	12
	Analyzing	10	8	9	10
	Reasoning	15	17	15	15
	Explaining	2		4	3

Team Two

Table 9. *Team Two Students' Learning Style Self-Evaluation*

	CE	RO	AC	AE	AE-RO	AC-CE	Styles
T2P1	32	29	25	34	5	-7	Divergent
T2P2	25	34	27	34	0	2	Divergent
T2P3	34	31	32	23	-8	-2	Divergent
T2P4	25	32	29	34	2	4	Assimilating

The above scores (Table 9) show how much each student in Team Two relied on each of the four different learning modes: students T2P1, T2P2 and T2P4 shared the same highest score at Active Experience (34) and T2P2 even had same highest score at Reflective Observation mode (34). In student T2P4's learning preference mode, Reflective Observation score followed at 32, Abstract Conceptualization was 29 and the lowest on at Concrete Experimentation (25); student T2P1 had the second high score at Concrete Experience (32) while Reflective Observation and Abstract Conceptualization scored 29 and 25; student T2P3 had the highest score at Concrete Experience (34), while Abstract Conceptualization closed at 32, and Reflective Observation

score rated at 31 and the lowest one at Active Experimentation (23); T2P2 had her two lower score at Abstract Conceptualization (27) and Concrete Experience (25).

Now we plot students' scores on the different Cycle of Learning graph separately and we saw their different kite shapes. Again, remember that the closer the dots are to the 100% ring on the circle, the more there is a tendency to use that way of learning. T2P1's kite shape showed that her tendency was to use the Concrete Experience learning mode, while T2P4 and T2P2 might use the Reflective Observation learning mode more, and T2P3' kite shape showed that dots close to the Concrete Experience and Abstract Conceptualization almost equally.

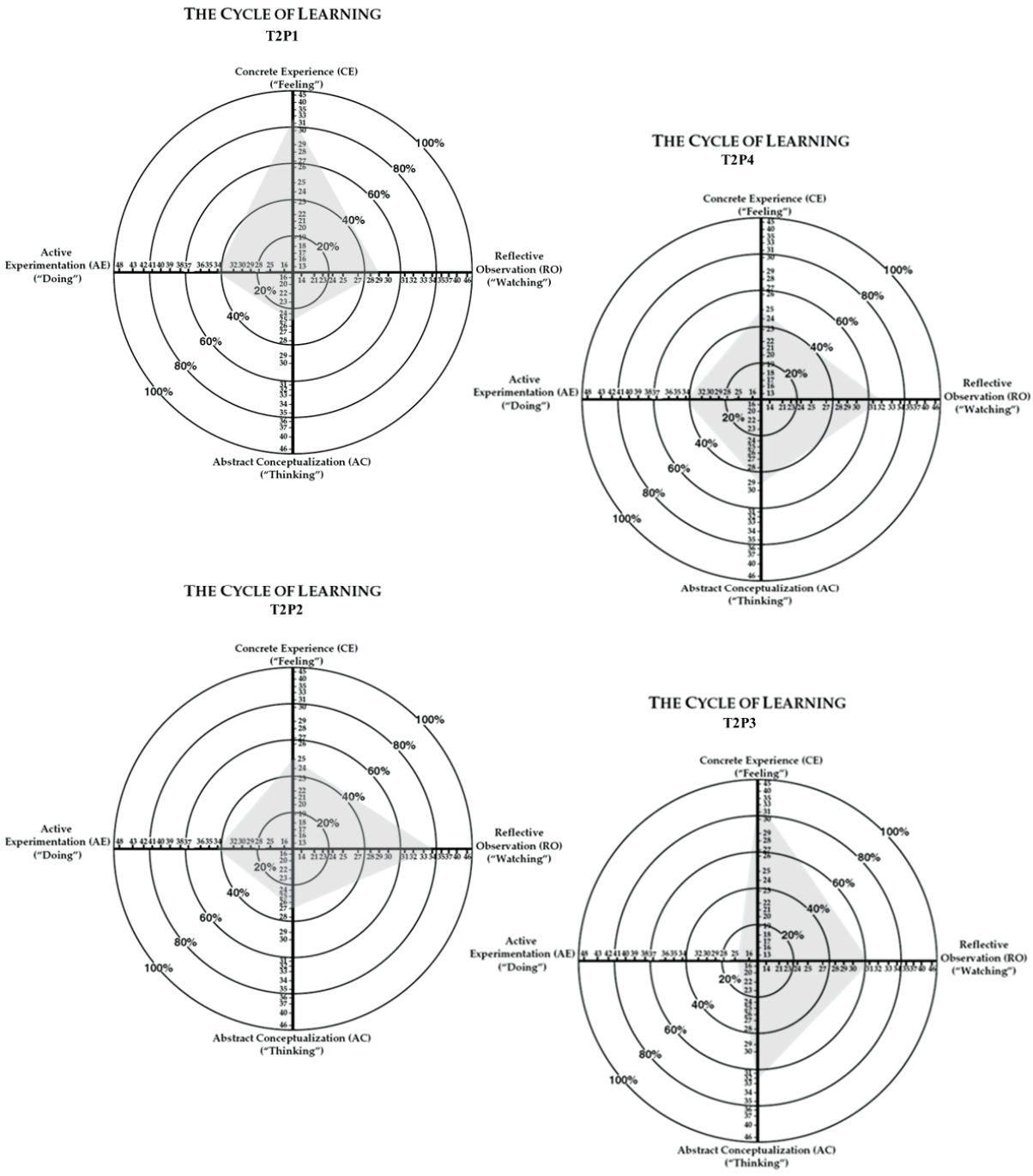

Figure 10. Team Two Students' Cycle of Learning.

The combined scores (AC-CE & AE-RO) in the Table 9 describe each student's dominant learning style. Plotting each student's score in the Learning Style Type Grid (Kolb. 1999), we saw that except for T2P4, who self-evaluated herself as Assimilating learning style (combination of Reflective Observation and Abstract Conceptualization modes), all the other three students self-evaluated themselves as having a Divergent learning style (combination of Reflective Observation and Concrete Experience). According to Kolb (1999), people with an Assimilating learning style focus less on people and are more interested in abstract ideas and concepts. They prefer lectures, readings, exploring analytical models and having time to think things through (Kolb, 1999, p 7).

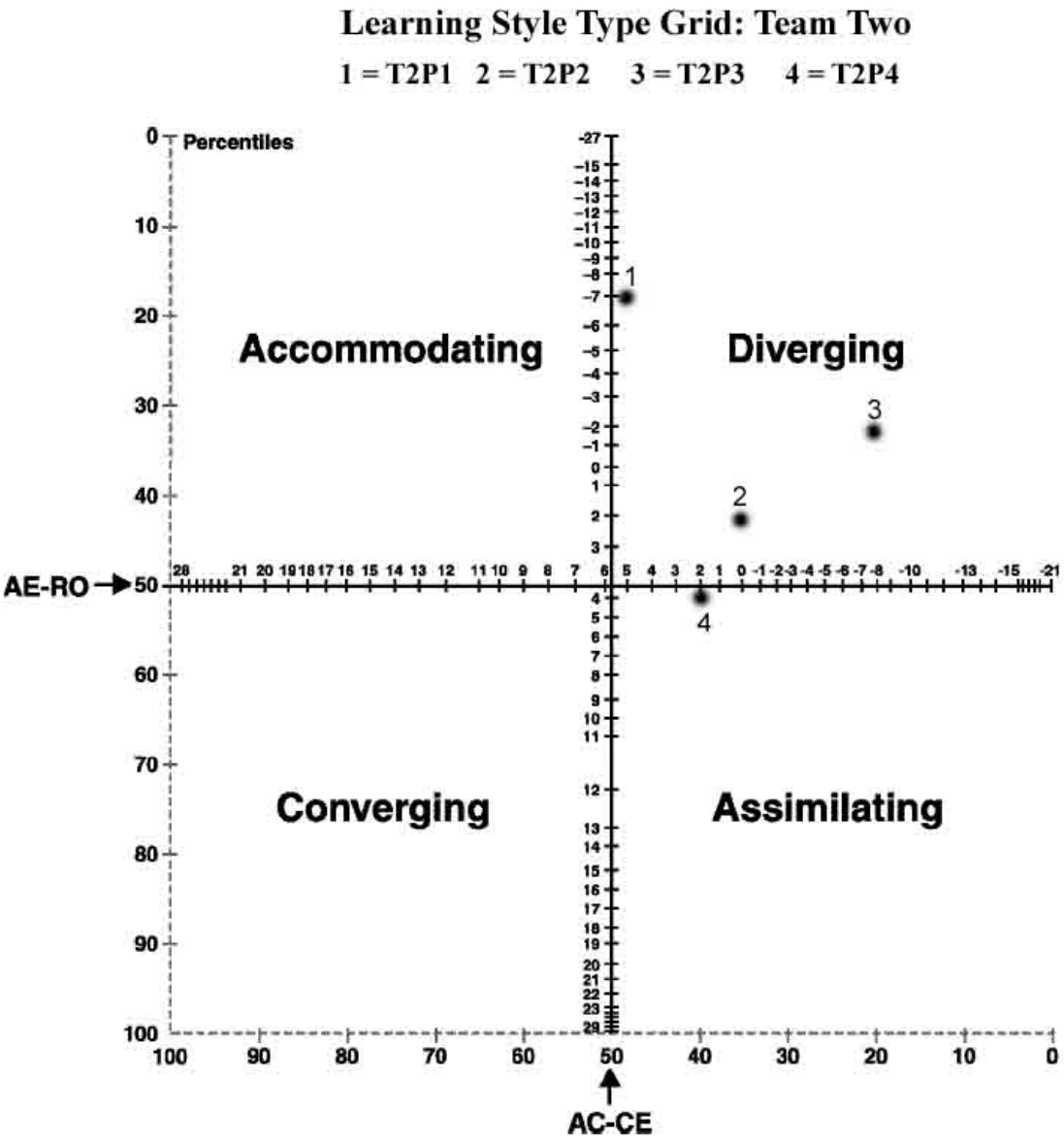

Figure 11. Team Two Learning Style Type Grid.

Now we look at the results of the content analysis from discussion postings in this group. This team consisted of two subgroups that each two of them had face-to-face meetings, so the number of the discussion postings was less than for the Team One. The situation in which one student posted for her subgroup partner was normal in this group.

Table 10. *Team Two Students' Learning Style Content Analysis based on discussion postings*

Learning styles/name	T2P1	T2P2	T2P3	T2P4
Convergent	20	18	**26**	18
Divergent	35	**24**	25	**27**
Assimilating	7	3	10	10
Accommodating	**40**	7	19	11

Table 10 showed the results of a content analysis of discussion posts based on the characteristics of the four learning styles (see Appendix C for complete coding of subcategories). T2P1 had highest score at Accommodating learning style(40) in discussion postings rather than the predicted Divergent learning style; while T2P2 and T2P4 had highest score in the category of Divergent learning style (24 and 27); and T2P3 had highest score in Convergent (26). .

Table 11 below also showed that student T2P1 took an active role in the group. She initiated projects and discussion, explained assignments, organized the project procedures and reminded group members of the deadlines; at the same time, she also depended on her peers to make decisions. Among T2P3's posts we can see that she was a decision-maker in this group most of the time. Other group members took more of a supportive role.

Table 11. *Team Two Student Collaboration Content Analysis Results*

		T2P1	T2P2	T2P3	T2P4
Leadership	Decision making	3	1	3	6
	Tutoring	1	1	2	0
	Explaining assign	6	3	0	1
	Organizing	3	0	1	1
	Initiating project	5	3	1	1
	Initiating discussion	5	3	0	0
	Affirming	0	3	4	1

	Evaluating	1	2	2	1
	Pushing process	3	0	1	2
	Reminding	4	0	0	0
Support	Offering help	0	1	0	0
	Interrogating	6	5	0	1
	Responding	3	6	8	7
	Suggesting	3	4	5	2
	Asking for help	0	1	0	1
	Depending on others	6	0	0	0
	Brainstorming	4	1	6	3
	Asking for confirmation	7	3	3	4
	What do you think?	6	5	1	1
	Providing info	11	4	2	8
	Focusing on details	1	1	0	0
Negotiation	Agreeing	7	16	14	13
	Disagreeing	0	0	0	0
	Chit chatting	7	1	2	2
	Encouraging	4	5	4	4
	Confusing	2	1	0	1
	Arguing	0	2	1	1
	Conflict	0	0	0	0
	Worrying	4	0	1	1
	Concerning others	0	1	0	0
	Thanks	1	2	3	4
	Complaining	0	0	0	0
	Apologizing	2	2	1	2
Cognition	Demonstrating	1	5	1	4
	Analyzing	1	4	4	2
	Reasoning	2	4	6	3
	Explaining	4	1	1	1

criticizing	0	0	0	1

Team Three

Table 12. *Team Three Students' Learning Style Self-Evaluation*

	CE	RO	AC	AE	AE-RO	AC-CE	Styles
T3P1	32	29	28	31	2	-4	Divergent
T3P2	32	33	29	28	-5	-3	Divergent
T3P3	25	32	25	38	6	0	Accommodating

The above scores showed how much each student in Team Three relied on each of the four different learning modes: T3P1 had the highest score in the category of Concrete Experience (32), and then the second in Active Experimentation (31), then Reflective Observation followed (29) and the lowest one in Abstract Conceptualization (28). Student T3P2 scored highest one in Reflective Observation (33), Concrete Experience was 32, the Abstract Conceptualization score was 29 and the lowest was in Active Experimentation (28). T3P3 scored the highest in Active Experimentation (38), followed by the second score at Reflective Observation (32), and then the same score in Concrete Experience and Abstract Conceptualization (25).

Now we plot students' score on the Cycle of Learning graph separately and we can see the different kite shapes. T3P1's kite shape showed the dots close to the Concrete Experience learning mode, while T3P2's were close to Concrete Experience and Reflective Observation, and T3P3's were equally closed to Active Experimentation and Reflective Observation.

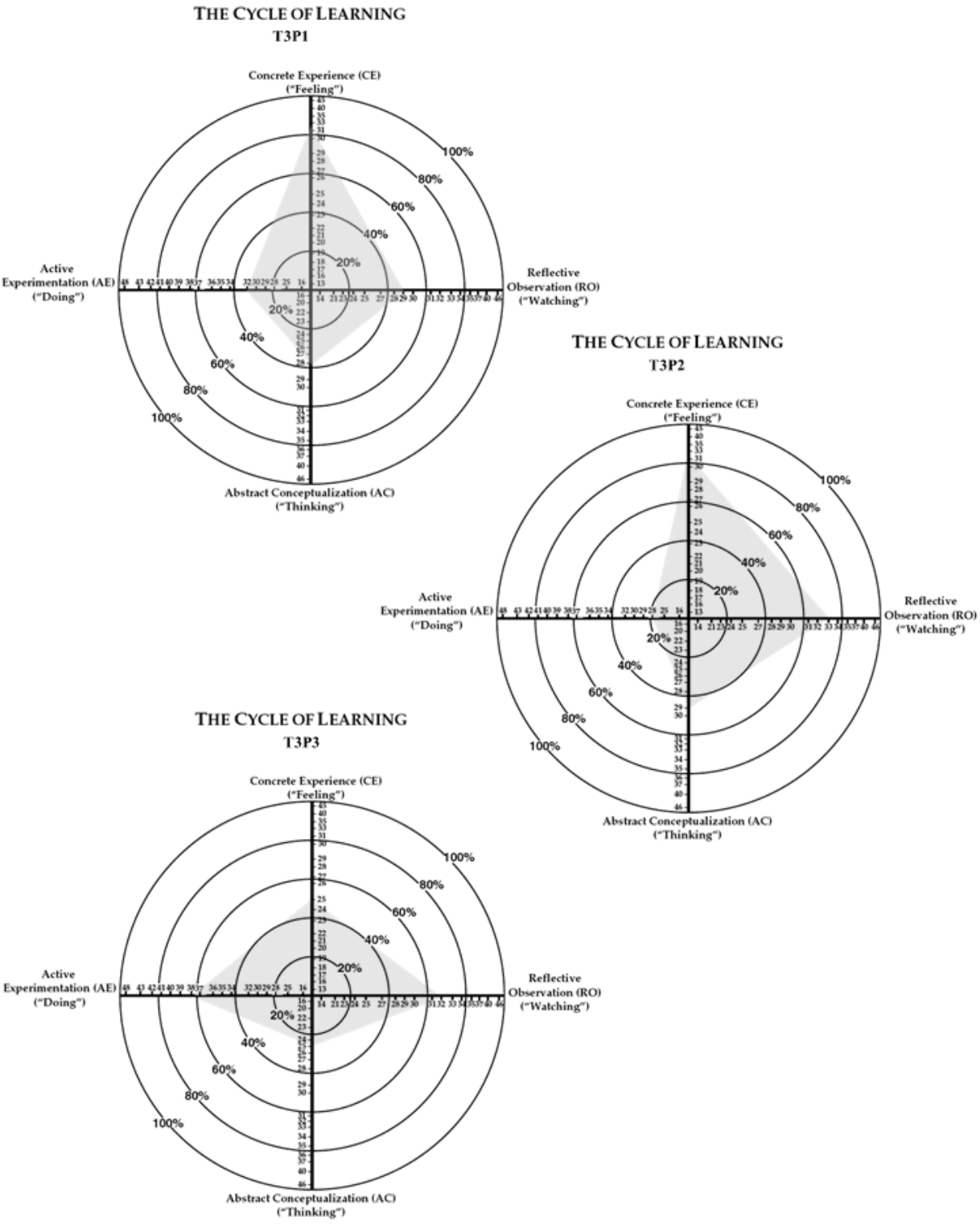

Figure 12. Team Three Members' Cycles of Learning.

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The combined scores (AC-CE & AE-RO) in Table 12 described each student's dominant learning style. Plotting each student's score in the Learning Style Type Grid (Kolb, 1999), we can see that T3P3 self-evaluated herself as Accommodating (Active Experimentation and Concrete Experience) while T3P1 and T3P2 self-evaluated themselves as Divergent (Concrete Experience and Reflective Observation). According to Kolb (1999), people with the Accommodating learning style have the ability to learn primarily from "hands-on" experience. They enjoy being involved in new and challenging experiences. In solving problems, they may rely more heavily on people for information than on their own analysis. In formal learning situations, they prefer to work with others to get assignments done, to set goals, to do field work, and to test out different approaches to completing a project (Kolb, 1999, p 7).

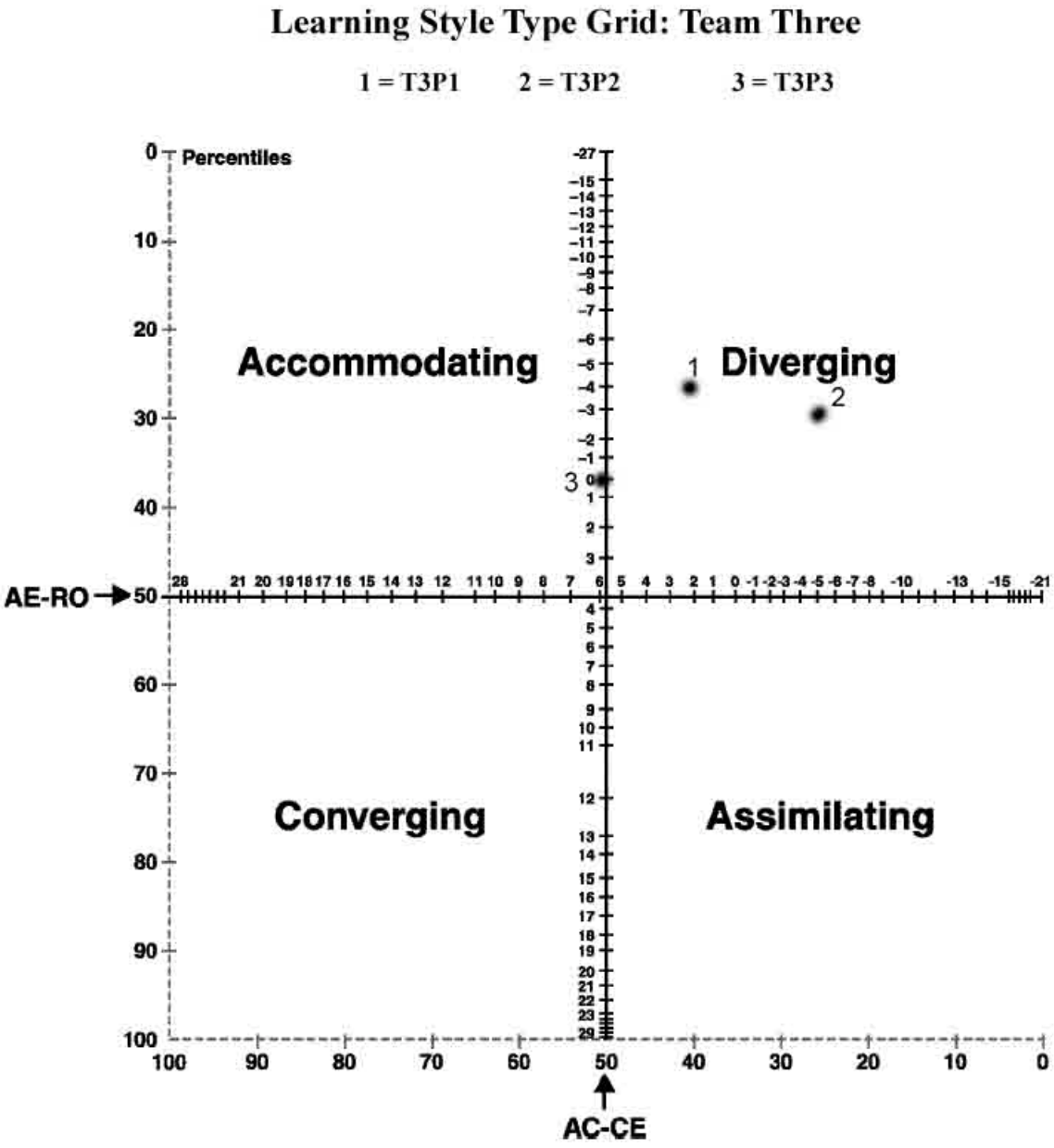

Figure 13. Team Three Learning Style Type Grid.

Now we look at the results of the content analysis from discussion postings in this group. This group generated the most postings in the whole class.

Table 13. *Team Three Learning Style content analysis based on discussion postings*

Learning styles/name	T3P1	T3P2	T3P3
Convergent	**94**	38	81
Divergent	59	**107**	52
Assimilating	12	14	12
Accommodating	36	24	**142**

Table 13 was generated from the content analysis of discussion posts based on the characteristics of the four learning styles (see Appendix D for complete coding of subcategories). T3P1 had the highest score in the category of Convergent learning style (94) among the four learning styles, which was different from her self-evaluation results [Divergent]. T3P2 had the highest score in Divergent learning style (107), while T3P3 had the highest score in Accommodating learning style (142).

In the following Table 14, we can see that the collaboration process was quite intense in this group. Three of them shared equal high scores at “suggesting,” “responding,” “agreeing,” etc. Student T3P3 also had high postings in “asking for help,” “depending on the others,” “interrogating,” which was consistent with the characteristics of the Accommodating learning style, and “decision making,” organizing,” and “initiating discussion” postings were consistent with the characteristics of the Convergent learning style. T3P2 participated in a more supportive role while T3P1 took a leadership role as well.

Table 14. *Team Three Students’ Collaboration Content Analysis Results*

		T3P1	T3P2	T3P3
Leadership	Decision making	11	8	14
	Tutoring	6	9	1
	Explaining assign	7	10	6

	Organizing	13	5	10
	Initiating project	5	7	2
	Initiating discussion	6	2	10
	Affirming	4	5	3
	Evaluating	0	0	1
	Pushing process	3	1	3
	Reminding	3	2	4
	Problem solving	3	2	2
	Capitalizing	0	0	0
Support	Offering help	9	10	4
	Interrogating	7	14	27
	Responding	15	15	14
	Suggesting	25	21	38
	Asking for help	3	4	12
	Depending on others	6	1	10
	Brainstorming	5	3	4
	Asking for confirmation	17	10	9
	What do you think	7	5	11
	Providing info	8	4	26
	Focusing on details	1	2	26
Negotiation	Agreeing	24	26	16
	Disagreeing	1	2	4
	Chit chatting	13	11	22
	Encouraging	3	9	3
	Confusing	5	3	4
	Arguing	3	5	12
	Conflict	0	0	1
	Worrying	4	2	6
	Concerning others	4	8	3
	Thanks	19	21	13

	Complaining	1	0	4
	Apologizing	3	6	10
Cognition	Demonstrating	10	4	10
	Analyzing	10	9	19
	Reasoning	9	11	15
	Explaining	11	3	9
	Criticizing	0	0	10

Team Four

Table 15. *Team Four Students' Learning Style Self-Evaluation*

	CE	RO	AC	AE	AE-RO	AC-CE	Styles
T4P1	36	32	24	28	-4	-12	Divergent
T4P2	31	24	34	31	7	3	Accommodating
T4P3	37	28	27	28	0	-10	Divergent

The above scores showed how much each student in Team Four relied on each of the four different learning modes: T4P1 had the highest score in Concrete Experience (36), and then the second highest in Reflective Observation (32), Active Experience followed at 28 and the lowest was Abstract Conceptualization (24); student T4P2 scored highest one in Abstract Conceptualization (34), while Concrete Experience and Active Experimentation were equally rated at 31 and Reflective Observation comes in as the lowest (24); T4P3 had the highest score in Concrete Experience (37), followed by the second highest at Reflective Observation and Active Experimentation (28), closely followed by Abstract Conceptualization at 27. T4P3 and T4P1 shared a very similar high score in Concrete Experience (37 & 36), and also T4P1 had the highest Reflective Observation score (32) in the group.

Now we plot students' score on the different Cycle of Learning graph separately and we see that T4P1's and T4P3's kite shapes showed the dots close to the Concrete Experience learning mode, while T4P2's kite shape was equally close to Concrete Experience and Abstract Conceptualization.

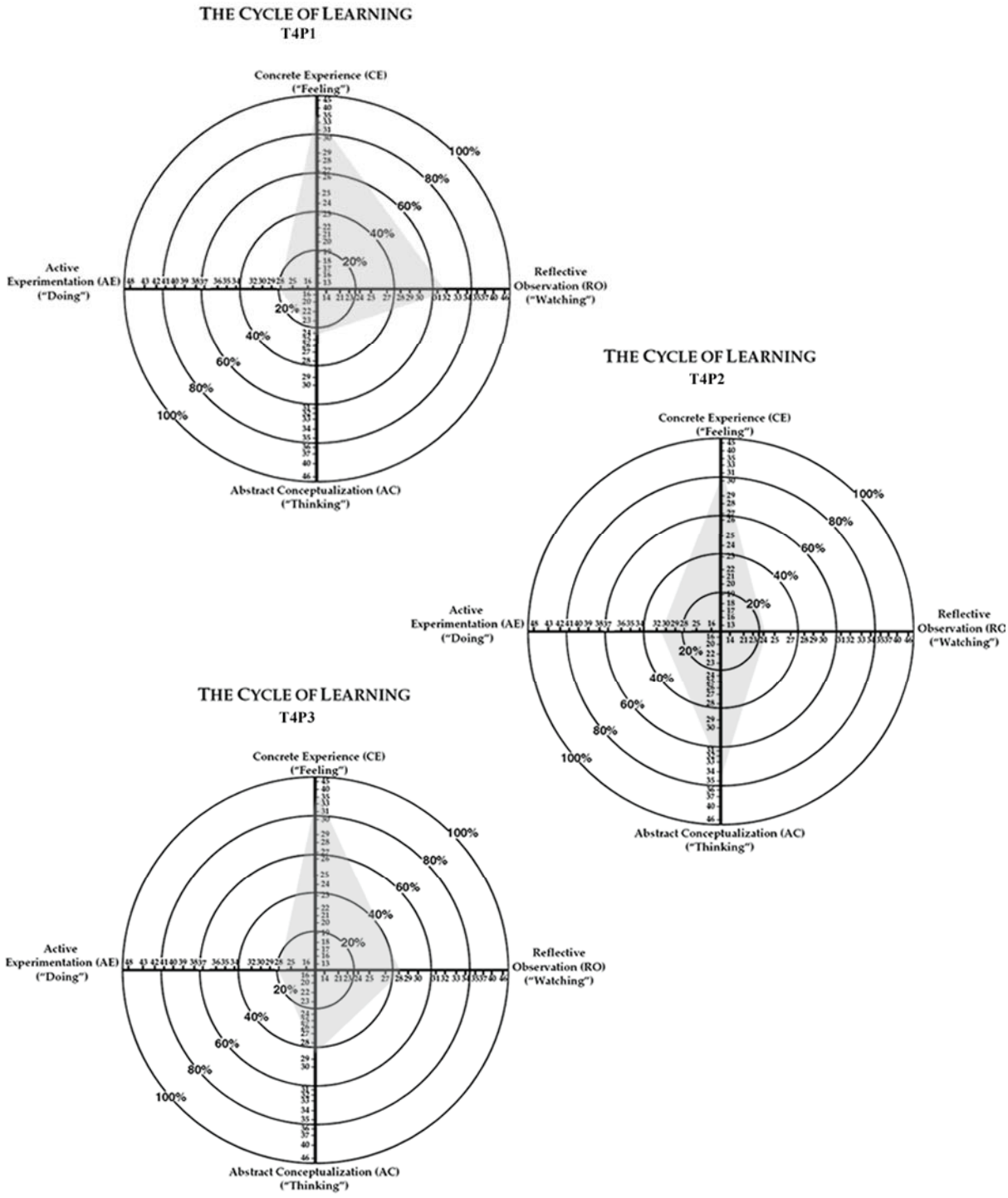

Figure 14. Team Four Students' Cycle of Learning.

The combined scores (AC-CE & AE-RO) in Table 15 described each student's dominant learning styles. Plotting each student's score in the Learning Style Type Grid (Kolb, 1999), we

see that T4P2 self-evaluated herself as Accommodating, (Active Experimentation and Concrete Experience), while T4P1 and T4P3 self-evaluated themselves as Divergent (Concrete Experience and Reflective Observation).

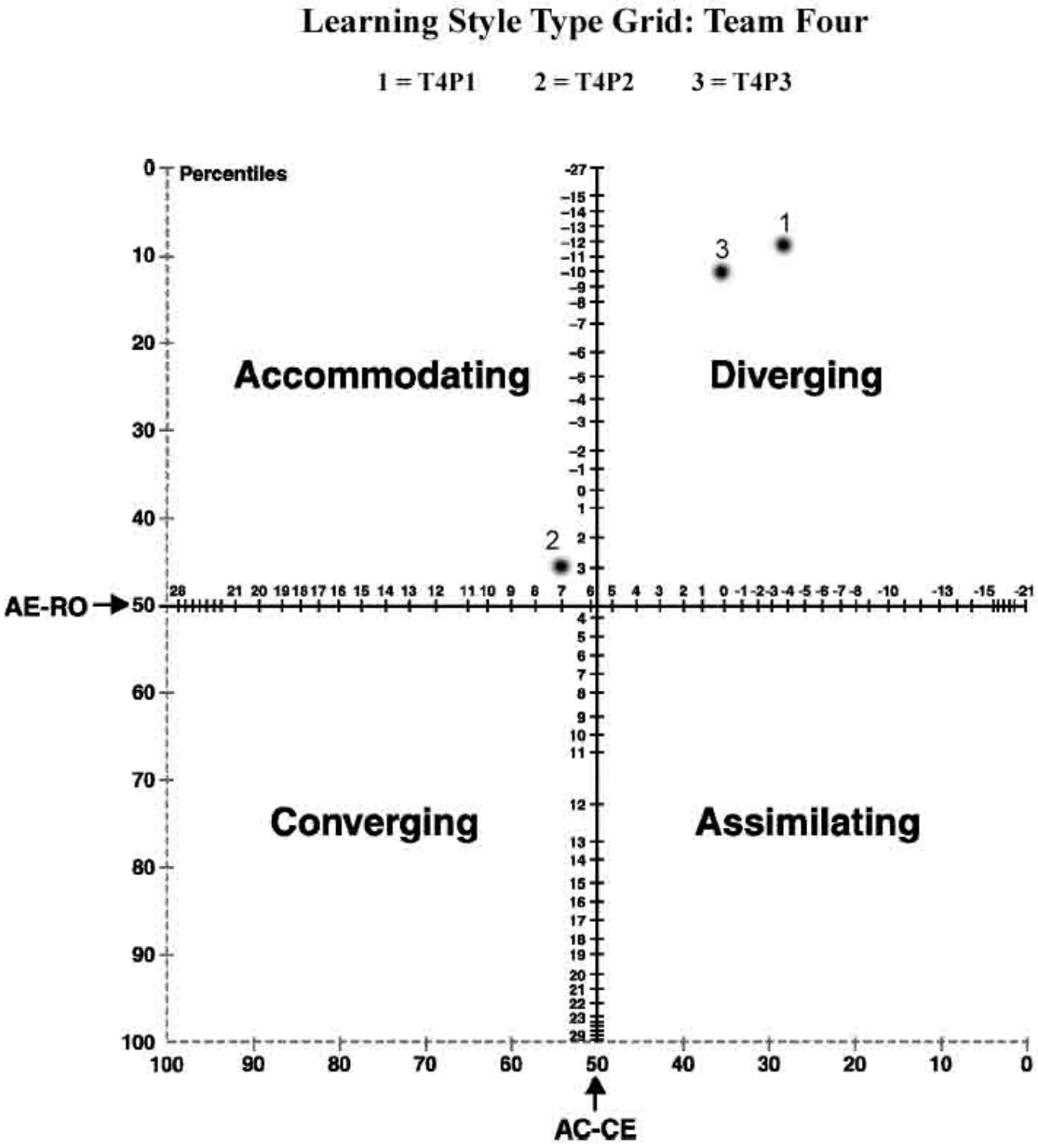

Figure 15. Team Four Learning Style Type Grid.

Now we look at the results of the content analysis from discussion postings in this group. The discussion was not very heavy in this group.

Table 16. *Team Four Students' Learning Style Content Analysis based on discussion postings*

Learning styles/name	T4P1	T4P2	T4P3
Convergent	10	**12**	18
Divergent	**31**	**12**	24
Assimilating	6	6	9
Accommodating	3	2	**28**

Table 16 was generated from the content analysis of discussion posts based on the characteristics of the four learning styles (see Appendix E for complete coding of subcategories). T4P3 had the highest score in Accommodating (28), which was different from her self-evaluation results. T4P1 had the highest score in Divergent (31), while T4P2 had her highest score in Divergent and Convergent (12), which was different from her self-evaluation result too. Comparing in the group members, T4P3 had the highest score in Convergent (18>12>10) and Accommodating (28>3>2) in the whole group, while T4P1 had the highest score in Divergent (31>24>12) among three of them. The difference will be discussed in the next chapter.

In the following Table 17, we can see that the students' collaboration process was not very active in this group. Student T4P3 had more postings in the Leadership category compared to the other two group members, and T4P1 showed a more supportive role in his participation behaviors.

Table 17. *Team Four Student Collaboration Content Analysis Results*

		T4P1	T4P2	T4P3
Leadership	Decision making	2	1	7
	Tutoring	0	0	1

	Explaining assign	0	0	4
	Organizing	2	0	4
	Initiating project	0	0	7
	Initiating discussion	0	1	4
	Affirming	1	0	2
	Evaluating	2	0	2
	Pushing process	0	0	2
	Reminding	0	0	3
	Problem solving	0	0	0
	Capitalizing	0	0	0
Support	Offering help	3	0	2
	Interrogating	1	3	5
	Responding	6	5	2
	Suggesting	1	2	6
	Asking for help	1	0	1
	Depending on others	0	0	0
	Brainstorming	1	0	2
	Asking for confirmation	0	0	0
	What do you think	0	0	6
	Providing info	0	1	2
	Focusing on details	0	0	0
Negotiation	Agreeing	4	4	6
	Disagreeing	0	0	1
	Chit chatting	2	4	6
	Encouraging	0	0	2
	Confusing	0	0	0
	Arguing	1	0	0
	Conflict	0	1	1
	Worrying	0	0	0
	Concerning others	0	0	4
	Thanks	3	0	8

	Complaining	0	0	0
	Apologizing	2	3	2
Cognition	Demonstrating	5	0	5
	Analyzing	6	1	5
	Reasoning	0	3	1
	Explaining	1	1	2
	Criticizing	1	0	1

Team Five

This group took advantage of the same location and met face-to-face in almost every project. And they did not have any discussion postings at all in the third project. Also, one of the group members filled out the self-evaluation Learning Style Inventory wrong so that his result was missing in this description.

Table 18. *Team Five Students' Learning Style Self-Evaluation*

	CE	RO	AC	AE	AE-RO	AC-CE	Styles
T5P1	34	26	33	36	10	-1	Accommodating
T5P2	27	32	33	28	-4	6	Assimilating
T5P3	36	27	30	27	0	-6	Divergent

The above scores showed how much each student whose LSI was correctly filled out in the Team Five relied on each of the four different learning modes: student T5P3 had the highest score in Concrete Experience (36), and then the second one in Abstract Conceptualization (30), while Active Experience and Reflective Observation rated same at 27; student T5P2 scored highest one in Abstract Conceptualization (33), while Reflective Observation was 32, Active Experimentation was 28 and Concrete Experience came in as the lowest (27); T5P1 scored the highest in Active Experimentation (36), followed by the Concrete Experience (34), then Active

Experimentation was 33 while Reflective Observation was the lowest 26. Comparing among the group members, T5P3 had the highest score at Concrete Experience than others (36>34>27), while T5P2 had the highest score at Reflective Observation than others (32>27>26). T5P1 had the highest score at the Active Experimentation than others (36>28>27).

T5P1's kite shape (see Figure 16) showed that the dots were equally close to the Concrete Experience and Abstract Conceptualization, and the dot in T5P2's was close to the Abstract Conceptualization and Reflective Observation. T5P3's kite shape showed that the dots close to the Concrete Experience.

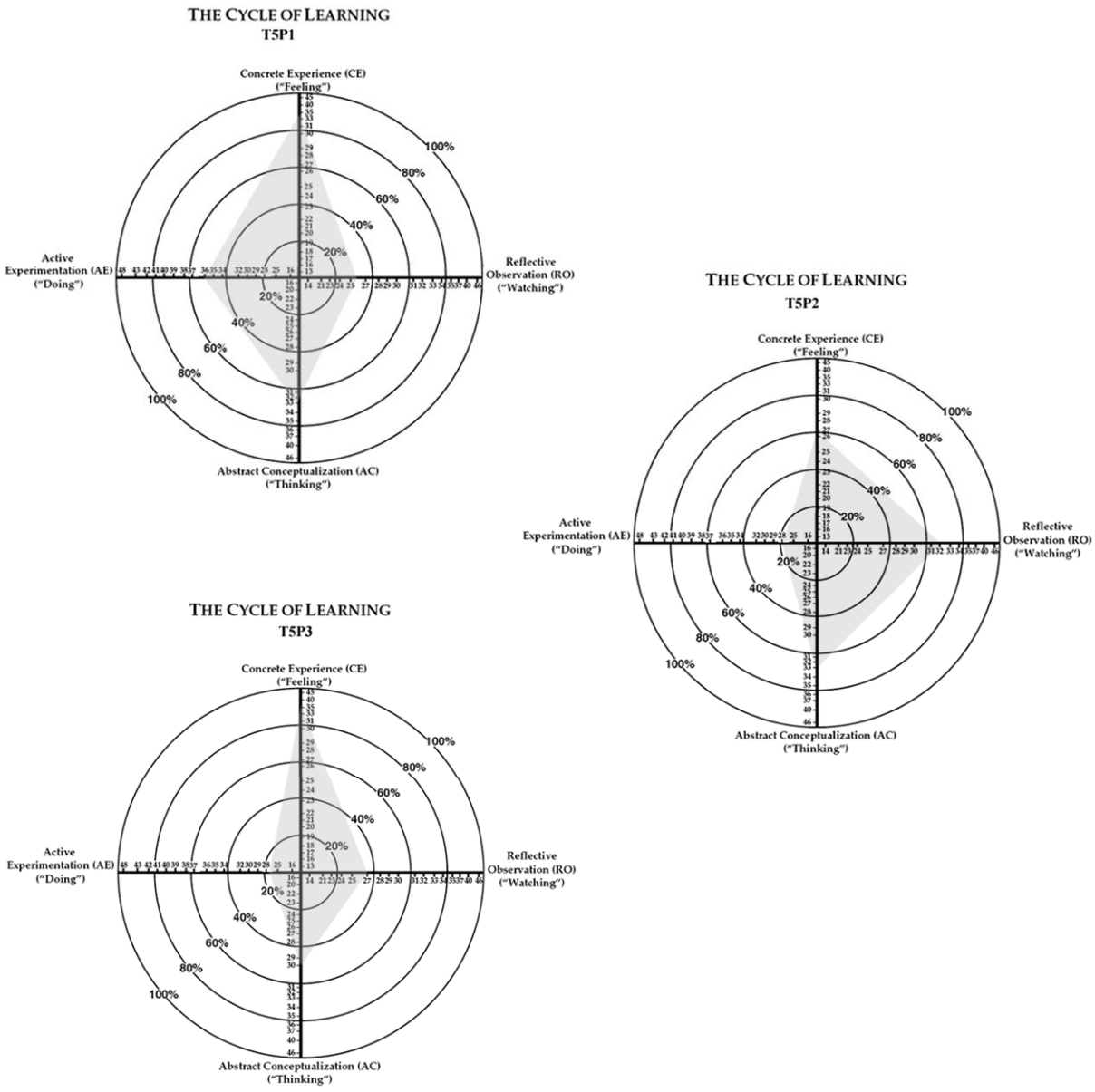

Figure 16. Team Five Students' Cycle of Learning.

The combined scores (AC-CE & AE-RO) in the Table 18 described T5P1 self-evaluated herself as Accommodating, while T5P2 self-evaluated herself as Assimilating, and T5P3 self-evaluated himself as Divergent.

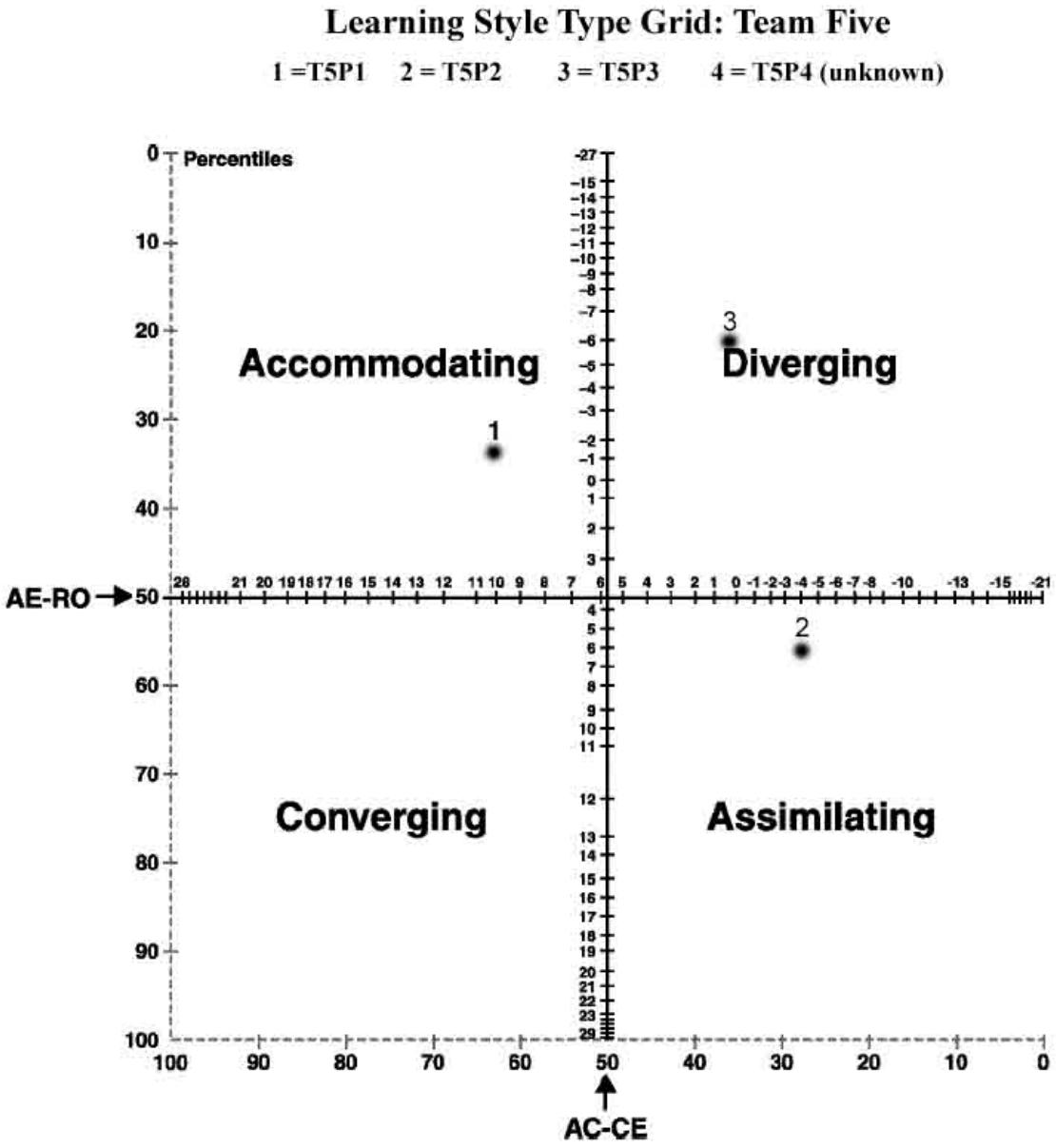

Figure 17. Team Five Learning Style Type Grid.

Now we took a look at the content analysis results from the discussion postings. The discussion postings in this group were mostly about the arrangement of the face-to-face meeting except the first two parts of the discussion assignment. Due to missing data, I can only try to give as "thick" a description as possible about this group.

Table 19. *Team Five Students' Learning Style Content Analysis based on discussion postings*

Learning styles/name	T5P1	T5P2	T5P3	T5P4
Convergent	21	10	9	1
Divergent	**23**	**14**	**12**	**4**
Assimilating	9	7	3	3
Accommodating	8	9	2	4

Table 19 was generated from the content analysis of discussion posts based on the characteristics of the four learning styles (see Appendix F for complete coding of subcategories). T5P2 had the highest score in the category of Divergent (14), which was different from her self-evaluation results of Assimilating. T5P1 had the highest score in Divergent style (23), also different from the self-evaluation result of Accommodating, while T5P3 had her highest score in Divergent (12). Comparing members of this group, T5P1 had the highest score at Convergent (21>10>9>1) and Divergent (23>14>12>4) in the whole group.

In the following Table 20, we can see that the students' collaboration process was not active in this group. T5P1 was the one who initiated the project and pushed the project. T5P2 showed more of a supportive role in her participation behaviors.

Table 20. *Team Five Students' Collaboration Content Analysis Results*

		T5P1	T5P2	T5P3	T5P4
Leadership	Decision making	2	1	2	1
	Tutoring	1	0	0	0
	Explaining assign	1	0	0	0
	Organizing	2	3	2	0
	Initiating project	1	3	0	0
	Initiating discussion	2	0	0	0
	Affirming	0	1	0	0

	Evaluating	1	1	1	0
	Pushing process	1	1	0	0
	Reminding	1	0	0	0
	Problem solving	1	0	0	0
	Capitalizing	0	0	0	0
Support	Offering help	1	1	1	0
	Interrogating	2	0	0	0
	Responding	5	2	1	3
	Suggesting	7	2	1	0
	Asking for help	0	0	0	0
	Depending on others	1	3	0	1
	Brainstorming	1	1	0	1
	Asking for confirmation	0	0	0	0
	What do you think?	0	0	0	0
	Providing info	2	1	0	1
	Focusing on details	0	0	0	0
Negotiation	Agreeing	7	3	1	0
	Disagreeing	0	1	0	0
	Chit chatting	1	0	0	1
	Encouraging	1	0	1	0
	Confusing	1	0	0	0
	Arguing	0	0	0	1
	Conflict	0	0	0	0
	Worrying	1	1	0	0
	Concerning others	1	0	0	0
	Thanks	1	0	1	1
	Complaining	0	0	0	0
	Apologizing	1	0	1	0
Cognition	Demonstrating	4	3	3	2
	Analyzing	4	6	5	1
	Reasoning	1	2	2	1

Explaining	5	5	5	5
Criticizing	1	1	0	1

Group Discussion Results

Student discussions in each group were very different from each other. In this section, I first give a "thick description" for the each group so that the reader can understand them more clearly.

Team One (4 members. All Classified by the LSI as Divergent, but showed Divergent, Convergent, and Accommodating combination from the content analysis.

Learning Environment

Getting familiar with the Blackboard system is very important for students if they are to participate in the class efficiently and in a timely fashion. Although students became somewhat familiar with the online learning environment from the icebreaker activity, they still needed time to get used to the discussion board for the collaborative project. T1P2 first posted her discussion in the main discussion board instead of the group discussion board; T1P1 had to post one thread about how to post a summary like this:

> T1P1: This is where we post our INDIVIDUALLY discussions then ONE of us post a summary of all of our discussions to the classes discussion board… when I went to post my discussion for chapter 4, I saw that a summary was already on the main discussion board and I haven't even done my assignment yet.

With this reminder, T1P2 realized that she made a mistake and apologized to the group. On the due date, when she wanted to post the summary again, she figured out that another group member T1P4 had not posted her own thoughts yet, and she addressed this to the group discussion board in this way:

> T1P2: I told her that I would post for the group today, not realizing that you had not posted your individual thoughts. Are you going to post for the group today? …Just let me know.
> T1P4: I'm responding here so everybody knows we are good to go and all on the same page now.

By the last part of the first project, they got used to the discussion back and forth. The turn taking had increased a lot, and communication had been developed more than before.

> T1P1: That looks good to me for an outline.
> T1P3: I think what you have planned is fine. Can we add stations for review?
> T1P2: I will work some more on the actual lesson plan part. Tell me any tips you all have for me!
> T1P4: May I suggest you post first here…we can all help make sure whoever has agreed to create the group response followed Dr's instruction/guidelines in reporting.
> T1P2: I think your ideas are very good, I will add them to the lesson plan in the morning! … thank you for helping me out, I need some, as you could tell, sometimes the words just don't come out right!

From the students' feedback on the first project, T1P3 stated that she was concentrating *"so terribly hard to figure out the blackboard system that she lost all focus on the actual assignment."* In fact, she missed out on part of the requirement to summarize the discussion so they lost one point in the group grade for the project.

Leadership

Taking a leadership role and actively participating in the project discussion are the keys to conducting a successful project. Technology skills, teaching experience and student responsibility played an important role in taking initiative.

At the beginning of the group software review project, T1P1 initiated the whole discussion because she knew she would be out of town and could not access the Internet during her absence. She posted on the group discussion board:

> T1P1: I am going to be gone for the next 2 weekends, so I might pester you in getting these assignments done.

Then she immediately started the discussion, provided the resources found online, and proposed the software to be reviewed. After group made decision for the state/capital software, she quickly came up with some criteria and organized the discussion process.

> T1P1: I added a thread for each part of the project and we need to discuss under each thread and then we can write a summary this Thurs or Friday. I also added a thread for additional information that we need. I thought if we did this way, it would be easier to organize the data. I don't think we need to divide this up, we just each contribute to the threads then one of us can volunteer to write a summary by Saturday.

Although she said "I hate to push the people," she did push a lot in the whole discussion process by posting threads like "T1P3 WILL DO SUMMARY"

> T1P1: Okay, T1P3 volunteered to do the summary this time, so T1P3 by what day do you want use to have all of our discussion done by? Friday? Thursday night?

With all the capitalized titles and being somewhat "pushy", she showed that she was worried about offending other group members by saying:

> T1P1: Hope you don't mind me going ahead and organizing it this way, I just figured it would be easiest for whoever summarizes it for Saturday.

With T1P1's leadership, other group members T1P3, T1P4 and T1P2 cooperated with each other too. They also helped to explain and remind each other about the assignment and make suggestions and decisions.

> T1P2: Let's decide this by Monday night, or tonight!☺
> T1P3: Let's use the state capital software.
> T1P3: Well we have our software now we need to come up with10 evaluation criteria. Once we have done that we need to split up the criteria and find the information she has stated.
> T1P2: how about if we each think of three criteria to write about?
> T1P4: If T1P2 says the State Standards in Social Studies expects mastery of the Capitals…well, it obviously has educational value.
> T1P1: Definitely agree with T1P4 again.
> T1P3: I would say that being able to call someone or email someone is tech support.

During the second project, T1P1 had the technology skills and experience so she initiated and organized the project again and she split the discussion questions into different parts and put in the different threads so that everyone could contribute. And when the whole group needed to

come to an overall conclusion, she collected the different opinions from the group members and helped make decisions:

> T1P1: Okay, we each came up different examples… we need to come to a conclusion using the same "subject" for both questions… I liked T1P3's idea of health for the final overall discussion…

Eventually, all group members agreed with her suggestion and made the final submission successfully. T1P2 thanked T1P1 for *"helping out with this project and leading the rest of us through."*

T1P1 volunteered to create the WebQuest in Project 2 for the group since she was good at the web page design. She worked on the WebQuest all weekend and kept the group updated, and also asked for suggestions from other group members. Without hearing anything from her peers, she made the decisions for the page design and the site layout. Later on, T1P3 logged in the Blackboard, and gave her some suggestions through the group discussions to help her finally finish the project and submit firstly among the five groups.

> T1P1: hey I am going to start working on making a new website for the project based off of T1P3's site. As I work on it, I will update what I have and give you all the link. Thanks.
> T1P3: Let us know what we can do.
> T1P1: …look through the website and see what needs to be changed and let me know through the discussion board.
> T1P1; Still need more…1) check out our assignment directions for the webquest and see what needs to be changed…
> T1P3; I think that what you have is okay…
> …
> T1P1; I think I have it figured out. Forgot the last postings. I'm still a little confused about the grid. I am going to change it a little bit, I hope you don't mind T1P3. My only concern with the grid was that each block told them to do different directions that what was stated in their individual roles. So I changed the grid to match the roles better.

With the web design skills, T1P1 *"was the real driving force, because she has the technology competence to take our crude suggestions/attempt and really create a quality product."* Same comments came from T1P3 that *"T1P1 is the computer guru so she used our*

suggestions and implemented those ideas." But because two group members were sick, *"the collaboration got worse in the project (T1P1's feedback)."* And she did not want to do it by herself again.

For this group, the pertinent suggestion of increasing the work efficiency was a necessary step in developing a good collaborative project on time. Another group member taking initiative was T1P4. She did not post as many times as T1P1 did, but each time when she proposed something, her suggestion was accepted quickly. At the beginning of the first project, T1P4 proposed meeting face-to-face for the project discussion with T1P3 because they worked in the same building. She said, *"T1P3, it is kind of sad that you and I are in the same building and we must resort to talking like this! How can we change this and be more efficient? Can we establish some kind of schedule?"* Since that time, when it was possible, they met face-to-face during the whole semester. For the third project, considering the complexity of the project and the time issue, T1P4 first proposed *"will we need to meet then to get this started?"* T1P3 agreed that *"I would like to meet because this is too much going back and forth for me. I can't keep things straight."* This would be the first time for the group to meet face-to-face since orientation for the whole semester. They made a quick decision to meet face-to-face discussing the project and working together the following Saturday afternoon. The discussion was not recorded but the results turned out to be very successful. The students in their project journal did mention that this face-to-face meeting was very essential for the complicated project.

Collaboration

More minds thinking on a topic are always better than one. When the project became too complicated and required various types of knowledge and skills, students felt that the collaboration became very important and helpful and they did agree that they learned from each other and actively participated and helped each other to accomplish the project very well.

> T1P4: Thank goodness for the collaboration! If I had had to create a webquest on my own, I would have gone mad!
> T1P2: We all worked on this as a collaborative project. One person really does have to do the actual work and that is what T1P1 did.

Online collaboration required each student to take ownership during the project discussion by showing their concern to the others, posting and responding to their thoughts quickly and thoughtfully, paying attention to the requirements, and helping make decisions.

Students took different degrees of ownership in the group discussion. Unable to participate in the discussion on time, T1P1 wrote the message, "*just wanted you to know what I WILL find time to look over the lesson and see if I can think of anything else…I WILL do this before b/f Friday morning… I am just so busy…"* Because she posted this message, the other group members would not worry about the participation and working process. With her technology skills, T1P1 was confident enough to take a leadership role in the whole project. Other group members did appreciate her contribution:

> T1P2: "Thank you for getting the ball moving with our group."
> T1P3: "A person needs to be really functional on the computer … T1P1 has saved the day again. She downloaded it [Inspiration software]on her laptop. I don't know how we would have survived without her…"

On the other hand, T1P2 did not notify her group but participated late after the group submitted or wrapped up the summary without her contribution. Her carelessness in reading the others' posting caused other members' subtle complaint:

> T1P2: I notice that we are to develop an evaluation rubric for the lesson also, would you like me to work on this? I can, but I won't do this until Friday night.
> T1P1: The rubric is there. It's the 2nd page of the document.
> T1P2: wow, I am sorry that I didn't see the rubric it is very impressive. Nice work.

Problems

The first part of the discussion of project 3 was a struggle for the group because they were required to take different roles/perspectives to evaluate the website. Those perspectives seemed to be contradictory. At the conclusion of the project, writing the summary required the students to negotiate with each other. Some insisted on their opinion; some compromised their opinion to reach a common conclusion.

> T1P3: The two that you said were the worst were the two best for me because they were to work in groups and that was a positive for my role.

The difficult part of this online learning in general was about technology troubleshooting. Students needed to learn to ask for help from their peers. In this group, T1P1 was the only one who had online chat experience before, and so there was chaos among them at the beginning of the project as they asked questions about how to use it and what would be discussed. They helped each other understand the project requirements and also the technical questions like how to join in the chat room.

> T1P1: Chat room is already set up…All you have to do is join the session, everything else is taken care of. I went ahead and did it just b/c I figured I could figure out the in/outs faster (no offense)
> T1P3: Will I be able to get this downloaded at home? That scares me. I don't even know what a JAVA is?
> T1P1: yeah, you will be able to…you might not need it though…it could already be on there…try it before we set up a time to chat.

Asking for help from their family members or school tech support personnel was another way to solve technology problems:

> T1P2: I don't know about the rest of you, but my computer will not let me download the Geography map game. Did anyone else have this problem? My computer techie (husband) is out of town until Friday. So I must wait to play the game. I am sorry that I can't get this going tonight.

When facing failure, group members worked together to make a correction so that they could move on to the next step. After they submitted the project summary, they figured out that

they missed one section of defining their evaluation criteria and had lost several points. T1P3 who was in charge of summarizing felt very upset and kept apologizing for the mistakes.

> T1P3: Apparently, I don't know how to read instructions… I apologize for screwing things up.

Her peers replied and encouraged:

> T1P1: Hey, don't you worry about it. You still did a great job. It was a group project so we all should've done the other things as well.
> T1P2: Stop beating yourself up about last weeks assignment! We have a chance to fix our mistakes, and that is what really matters.

And at the same time, T1P1 took a leadership role again to initiate the thread for corrections to project. With the capitalized messages, she expressed strong ownership:

> T1P1: LET'S PUT OUR DISCUSSION HERE AND THEN I WILL SUMMARIZE IT AND RESUBMIT TO HER BY THURSDAY EVENING. IF YOU WANT TO HELP YOUR GRADE OUT, JOIN IN. REPLY TO THIS THREAD WITH SUGGESTIONS, IF NOT, NO BIG DEAL!
> T1P1: I say we use the email that she sent out as a guideline and reply under THIS thread. Lets' not go back and use the other threads.
> T1P1: Whoever wants to get a better grade: please feel free to respond to any or all of the above. I would like any suggestions or critiques to be done by Thursday 4:00

Due to the difficulty of the third project, all four of them felt confused about the instructions now and then. The postings about explanation of the instructions increased from the peers:

> T1P3: I am assuming that she is talking about the next assignment. She is giving each group an approach and we have to teach it to the rest of the groups. I believe we will be teaching them using the tool that we choose as a group (concept mapping or iMovie) Once we teach, we learn from the other groups about their approaches…
> T1P4: We are supposed to respond to 3 items after reading chapter 2 & 9, the Perkins article, and the Jonassen article…cooperative learning…thinking processes…does chat room work better/worse than threaded discussion…at least I think this is what we are supposed to do…plus we are supposed to "archive" this chat for later viewing.

Online communication methods

There are two types of online communication methods in Blackboard: asynchronous communication through discussion board and email, and synchronous communication through "lightweight chat room". Students' attitudes toward the two methods began changing with their

familiarity with the technology. After the first project, student feedback towards asynchronous communication showed some improvement was needed. T1P3 said *"I have enjoyed talking with my group members unfortunately I've lost their faces because we met once for about five minutes and since have communicated only through email. I think that more face-to-face time with instructors present would be beneficial."* In T1P2's feedback, she pointed out *"Sometimes when working in a group is difficult because not all of us get on the computer at the same time, and not all of us want to get done early while others are slowly at their project."* T1P4 directly indicated that the collaborative process had been difficult to accomplish through computer discussion because what was agreed upon by the group was later disregarded. And in terms of time, online collaboration was inefficient and caused the task to take "agonizingly forever" to complete because of having to "wait" for others to respond to the comment or to respond to other comments via asynchronous communication. Having a face-to-face meeting every week was even suggested.

After using the lightweight chat room and meeting face-to-face in the library, the group discussion postings decreased dramatically. When asked about students' opinions about the synchronous communication via chat, T1P1 wrote in her journal *"I type way too fast compared to my other teammates so it was kind of boring. I think we should've had a better discussion using the discussion board."* On the other hand, T1P3 wrote in her journal that *"The chat was not fun. I couldn't think long enough to complete a sentence before we were off on another question."* T1P4 agreed T1P3's thought but also suggested the better strategy for chatting, *"The chat room was really tough! I cannot think quick[ly] enough before someone else responded and then it seemed like I was conversing with someone else instead of the person I thought I was. I did not like it with four people, two would be fun though."*

Chatting with the instructor definitely helped students understand the instructions better although they did not like the chat at first. The synchronous communication set up with the instructor in chat room clarified students' confusion and made the project more workable:

> T1P4: So what is our assignment all about?
> The instructor: Ok, let's get all the confusions on the table.
> The instructor: The other 2 chats I've had ended up with people saying they felt much better!
> T1P3: Do we answer the questions that you gave us in a graphic organizer.
> The instructor: Yes, I would try to answer those (and other) Qs in a visual way…that makes you[r] thinking clear…and helps others to understand it and also ask Qs about it.
> T1P1: so we learn ALL WE CAN about multimedia and then try to put it in a way that other colleagues can learn it without the research?
> The instructor: T1P1, yes!
> T1P4: By collaborating to complete this, we should all be responsible for a certain portion of the driving questions?
> The instructor: T1P4, I think you should all decide your driving Q.
> …
> T1P1: DG, that's what I thought…thanks
> T1P2: That makes me feel better!
> T1P1: that's what I thought the project was but I guess that just didn't see right…different than anything ever before done.
> In the students' project journals, they confirmed the comfortable feeling saying,
> T1P1: 11/28/2005 Discussion online with Dr. I think it went well and I am feeling a lot better on the project now.
> T1P3: We are less confused after this chat…
> T1P2: I'm feeling more relaxed about the chat.
> T1P4: The chat with Dr. was easier, she used our initials to make sure we knew who she was responding to. Something so simple, and it helped so much!

Experiences

Students were learning from their experiences. At the first chat, T1P2 left the chat first and clicked the closed button instead of exit button, with the result that T1P1 could not archive the chat conversation for the later review, and she had to write the summary by memory. In the second chat– without the instructor– we could see the conversation:

> T1P3: are we out of here then?
> T1P4: Okay, ready to archive?
> T1P2: we can get off can't we now?
> T1P1: we don't need to archive, do we??? I don't think so.
> T1P3: I thought we did.
> T1P2: I think I started it before we started chatting, is that possible?
> T1P1: we don't need to refer back to it at any time

T1P4: I thought she emailed and so to do this so she could access this again.
T1P1: okay, hold on everyone
T1P2: what?
T1P1: I will start the archiving, but NO ONE leave until its done.

However, T1P2 had actually started the archiving at the beginning of the class, so they were safe to leave. We can see that everyone learned a lesson from the previous experience, and they made sure it was archived before they left the chat room.

Team Two (4 members, Classified by LSI as three Divergent and one Assimilating, but showed a combination of Divergent and Accommodating from content analysis)

Collaboration

In this group, two of the members worked at one school and other two worked together at another school, so essentially two pairs came together to make a team. Many discussions about this course were not posted online because they worked with each other in person. T2P1 in her feedback emphasized that they had done well at subdividing work in their team in order to be the most effective. They often worked in pairs to begin collaboration and then brought that consensus to the whole team. In this manner, each team member was represented. They also used email to increase the communication since everyone checked Blackboard at different times.

Taking responsibility was the key for collaboration. When the group members took strong initiative to get the work done, the collaboration resulted in a good product. They took turns posting the final discussion on the main discussion board to divide the work equally. T2P1 was the one who initiated and pushed most of time, and also relied on others' to make decision in this group. T2P3 was more involved in decision-making, and T2P2 and T2P4 were more supportive. T2P4 was the one who paid attention to the details.

> T2P1: I added this document with all the information that T2P4 and I have posted so far. Please add and or change as needed. It is in a Microsoft word document. If you can not open it, let me know. I figured this would be easier than going back through all of these messages to make a summary.

To be critical was the key to turning out a good product, rather than just making an agreement for the sake of being agreeable. In the group software evaluation section, all the members contributed their own thoughts and turned in the summary. By the end of it, T2P1 said, *"Looks great! We did a great job dividing up the work to get it done effectively…"* However, they still lost points by an error in categorizing the type of software. Once they got the feedback from the instructor, they realized where the problem was. T2P3 was the one who changed the plan very quickly once it had been critiqued.

Prompt responses

T2P4 proposed using one piece of software called *Wiggleworks* for the software review because two group members were familiar with it. T2P1 and T2P4 were online at the same time, their discussion ran very smoothly back and forth, and with T2P3's participation later that night, they quickly wrote down their summary based on T2P2's first draft.

Teaching experiences

Teaching experiences helped students choose a topic and also contributed to the discussion. It was the group's purpose to create a project that some of the members could use in their real classroom.

> T2P3: Do we have any idea of what content area we want to do? I am guessing that a science topic would be the easiest. I know T2P2 and I work with 1st graders, but I believe you two teach older grades. What grade level do we want to gear this toward? Does anyone have a unit they want to teach? I will be teaching the seasons and also a unit on the sun, moon and stars.
> T2P4: T2P1 also teaches 1st grade (I teach 5th) so lets just aim towards 1st grade so the 3 of you can actually use it.

And with their similar background, four students (also in-service teachers) could easily communicate with and understand each other. In this group, the discussion posts were more oriented toward the content rather than explaining the different concepts.

Difficulty

Collaboration during the project was quite difficult due to technology problems and different schedules and priorities. Although the discussion postings did not show any conflicts, the students' project feedback did reflect their struggling with online collaboration because it is really hard to work on something so "tedious" when the group does not really know each other and could not meet as a group together. T2P2 in her feedback wrote *"I also feel as though in order to get the collaboration done with my group members, I would have to be doing it when I'm supposed to be teaching. This makes me feel like a lousy teacher."* Another member T2P4 agreed that group projects and collaborative assignments are very beneficial to the learning process but also admitted, *"I don't really feel that our collaboration has improved, I just think we realized we have to do it whether we like it or not and we all want a good grade so we are trying our best regardless… it does require more time and effort to work over the internet entirely—whether on Blackboard or via email… The 2 other girls in our group are very nice and knowledgeable, they just have different schedules and priorities than T2P1 and I…"* T2P1 said, *"Since we have never met and live so far apart it makes things a challenge. It is hard for the group to collaborate because some of us are procrastinators and some are not."* T2P3 suggested *"such a large project that worth so many points of the course there should have been more guidance, support and time given."*

Team Three (3 members, classified by LSI as two Divergent and one Accommodating, but showed combination of Convergent, Divergent and Accommodating from content analysis)

Leadership

During the whole course, T3P1 organized the collaboration by splitting the task into different sections so that every group member was in charge of one part, and then she combined them at the summary. At the same time, everyone was required to give suggestions and feedback to the others' work. In this way, everyone could be encouraged to share their own experiences and previous knowledge. It was good to see the different opinions during the whole discussion process. With her teaching experiences, T3P1 was often the person who initiated the projects, as T3P3 said *"It is so good that you are always starting discussion in time ☺Thanks."*

Usability

Making the project usable was the group's purpose. T3P1 was a school teacher who brought her teaching experiences and problems to the group discussion so that other members would understand the real classroom situation and create a usable project. She made the decision to work on something she could use in her classroom:

> T3P1: I was thinking about doing a lesson plan over fractions that I could use with my 4th graders and integrate brainpop [software had been reviewed in this group] into it.
> T3P2: Fraction sounds good to me, especially if it will be helpful for you in your class.
> …
> T3P1: Does this [the lesson plan] make more sense? I guess I just wanted to try something that I could actually do with my class. If either of u have another idea for a lesson plan, just let me know. I am open to trying something new! ☺
> T3P3: I think your plan is great.
> T3P2: I think your lesson plan is a great idea. It's better to do something that will benefit someone.

In her project feedback, she said, *"I really appreciate the other two in my group allowing us to choose projects that I can actually use in my classroom. It makes the process much more authentic to me, and allows me to try out some of the projects that we've done."*

Motivation

Students' different purposes and motivation levels influenced how they participated and contributed to the project. Indeed, students' different motivations and academic aspirations led to considerable difficulties in this group. T3P3 was a highly motivated doctoral student, who wanted to explore all the reading and information to understand the project thoroughly. T3P1 preferred to answer the question and got the project done. In T3P3's journal, she said,

> "I got frustrated that we so not organized. I had already maid [made] a few posting with my findings and no conversation, no adequate reaction, I mean, discussions or debates."
>
> "T3P2 and T3P1 wrote that diagram is too complicated. I just surprised! I felt that I made only draft that we would have expand."
>
> "She [T3P1] said that we do not have make things complicated, but to make artifact for others to teach it has to have more concepts and resources as work with that. I just started to guide her carefully and carefully suggested her to put more things in diagram."
>
> "I … [know] how to manage to make changes in inspiration diagram from file exchange and how to send it back there. I could make any changes that I feel need and not to try to explain T3P1 who already not willing to make any changes because it is okay (just definition about hypermedia and examples - it is enough for her)."

She finally wrote *"I would like to work in a group where everybody really would be engaged and really interested to make good project. In this case, I could learn a lot from others, my part wouldn't be the main and because of that whole projects would be just much better*.

Collaboration

Successful collaboration resulted from the group members' strong sense of responsibility and contribution to the group.

For the group software review section or Project 1, after T3P2 and T3P1 had chosen the criteria, T3P3 was late for the discussion. She asked for more work to balance the workload among the group members. T3P1 suggested that she write the summary for the whole group. As a foreign student, her different cultural background and language were an issue for T3P3 to

communicate fluently and accurately in oral and written form, and she asked for the help from her peers:

> T3P3: I will make group software review. But it will be very helpful if you would look up this review, which I will write, before I will submit. Because I have never use software in teaching (T3P1, you used this software in your class!) and I am international student…maybe some of my points will be wrong.
> T3P1: I will just write up the final review if you want me to. It's not a big deal….does that sound okay?☺
> T3P3: Actually for me is interesting to write review too. … I just little bit confused, that I am writing not fluently and I won't d our software review as good as may American teacher would do. May be I [we] can do this review "together" it means that I will do main part and you with T3P2 can make suggestions and changes.
> T3P2: Thanks for writing it.

After she submitted the summary, she commented how helpful the collaboration was:

> T3P3: Yes, we have to share work. … T3P2's suggestion, when I was writing software review, was very useful for me!

In the tutee lesson plan section, T3P1 proposed creating one with the tutee tool *Keynote*. Without any experiences of *Keynote* and *PowerPoint*, T3P3 thought that web page design was the only tutee tool. Explanation and demonstration was then increased in the discussion board to explain the concept of tutee and *Keynote.*

> T3P3: Actually I don't know how works Keynote, if it works as PowerPoint, I don't think that it is TUTEE mode, but I can be wrong because I don't know this software.☺ Could you tell more about this software, why you think is TUTEE? I think our teacher emphasized that learning in TUTEE mode will be when students will create web page drive by content…
> T3P1: I guess the reason I am thinking keynote would work is because they are making a multimedia presentation. Part B lesson plan says "the primary requirement of your lesson should be a student created website/web page or multimedia presentation that will be the main piece of work that will be assessed. Does this make more sense?
> T3P2: I looked only to try and find some information about KEYNOTE. I've never used it before….is this information right T3P1?
> T3P2: I think Keynote will work because we have to either have the students create a webpage or multimedia presentation. Keynote has a multimedia presentation feature.
> T3P1: I tried to save an example as a PDF so you could kind of see what it looks like. This is a VERY generic example that I just put together in about 1 minute. Hopefully it'll give you an idea…

With this clarification, the discussion moved to the next topics concerning how to make it content driven and the rubric.

> T3P2: how do we make it more content driven? Would it be by having them learn the program, rather than actually making the presentation?
> T3P3: T3P2, I think content driven doesn't mean "learning program." Content driven means what is a lesson about. If T3P1 does lesson about fire fighters, here (in the process and product) emphasis has to be on some ideas and understandings about fire fighters, safety etc. (what T3P1 will want) and technology just will help more interactive be involved in learning and get deeper understanding.
> T3P1: T3P3, thanks for all of your suggestions! They were wonderful. And I think you are right, the lesson needs to be more students centered and content driven. I made some changes, please look over it and let me know what you both think.

By analyzing the success in collaboration, three of them had similar comments and identified each others' strengths and responsibilities that contributed to the group:

> T3P1: T3P3 is a real strength to our group because she reads over everything very carefully and notices small details that T3P2 and I may have missed. T3P2 is very organized and we can always count on her to be on time and complete with her work. I do feel lucky to because I have had outstanding groups so far in these online courses. I can see how it may be difficulty for other people who may have a person in their group that doesn't equally share in the responsibility of the assignments.

> T3P2: T3P3 does a good job of making us stop and think about what we are writing. T3P1 is a hard worker and has a lot of experience with some of the things we are working with. I tried my best to my part and give helpful feedback and listen to their feedback.

> T3P3: T3P1 always is good for starting task and discussion. She doesn't wait for anybody, just starts and it is very good for me. And she is very friendly and positive that we have good relationship and emotional atmosphere in our group. T3P2 is very friendly too. I like that she sometimes tells that she doesn't agree and can make suggestions, which is very helpful to improve our projects.

Creating a WebQuest was the toughest part of this second project because it required critical thinking, WebQuest knowledge, and web design skills. T3P2 came up with the topic–culture and food–and T3P1 and T3P3 did the searching online to find the information. They split 6 sections of the WebQuest among the 3 group members, so that each one was in charge of 2 sections. Considering the issue of consistency in design, T3P2 volunteered to take the design role and others contributed the content. This project turned out to be a very good collaboration among three members. Each of them took a role based on their experience: T3P1 was a teacher who wanted to bring everything to practice; T3P2 was familiar with the Dreamweaver software

and was good at the technology; and T3P3 saw herself as an educator who brought more educational theories and deeper insight into the discussion and was good at finding information and usually made sure everything was right. T3P2 in her feedback said, *"We all had roles that fit us."* The whole group shared an equal participation in the project. The fact that everyone checked Blackboard and emails on a regular basis enhanced the asynchronous communication. As an international student, T3P3 claimed that she learned not only to accept others' ideas even if she did not like them, but also to make suggestions and changes "bravely".

The conflicts in this group happened during the first section of the second project. Due to a family issue, T3P3 could not get online until T3P2 posted the summary, but she disagreed with some parts of the summary. First she worried about that other members submitted the group summary without including her input, T3P1 replied her that she did a wonderful job and her discussion had been integrated into the summary. And then, she asked whether she could make some changes about the summary that had been posted. T3P1 suggested her *"I think T3P2 posted it, but if you want to add something just go to the main discussion board and put a response under it. I think that will be okay."* Insisting to change the summary, T3P3 posted her correction in the group discussion board and suggested some deletion of the content. T3P2 helped out for the final summary but disagreed with the deletion.

It is normal to see disagreement in group discussions, but the issue in this case was that T3P3 was late to express her disagreement, which caused the conflict. T3P1 did not reply to T3P3's suggestion for the final version. The same thing happened in another section of the project when T3P2 was late with her contribution to the summary and she posted her thoughts in the group discussion board although the group had already posted the summary. Being able to participate in the discussion before the deadline was the key for good collaboration.

Good organization is a very important element to start a project. At the beginning of the third project, T3P3 posted her worries about the project by saying, *"I feel that we have to discuss more (to chat or to meet), because I think that we do not have good organization of our work right now. Nobody knows who doing what, not [no] strategies, no plain [plan] … everything is enough chaotic despite that this project is the biggest one. We have to talk what we already have, decide what we need and move quickly."* With this posting, she brought the group members together again.

Disagreement

Dealing with disagreement well is something that all the group members needed go through to conduct a successful project. One example in the first project is when discussing about the teacher's role, T3P3 had some suggestions for T3P2's contribution. She added one thread in the discussion entitled "small disagreement:"

> T3P3: That teacher role is most to assess—doesn't sound for me good☺…maybe we could say that she gives a little bit information, guides students and does formative assessment all the time…formative assessment is more about measuring student's understanding and progress (monitoring). I think if you would change assessment to formative assessment or monitoring of students understanding, it would sound better and would explain more.
> T3P1: Good point. We can add that in there as well.
> T3P2: Thanks for the feedback. What you say makes sense. I revised it. Let me know if I wrote what you mean.

Discussion like this did enhance students' understanding and critical thinking, and their assignment turned out very well. When T3P1 submitted the summary, T3P3, who had lots of questions to be confirmed with T3P1 and T3P2, responded quickly, *"that's very good!"* In T3P2's project feedback, she wrote, *"in this last assignment we all chose different parts and then gave feedback on each others…we had some initial disagreements and confusions, but they were helpful and made our answers better. We discussed through them and found and understanding that made sense.*" After emphasizing the positive side of the collaboration, T3P3 was not

satisfied, thinking that her partners saw things as a little bit simpler as she did. Her friends suggested that she speak out and she did try, and the reaction was quite positive and encouraging. She wrote in her feedback *"I just understand that I have to be more active and open, not to be afraid of defense my opinion and we just have to discuss much more before the writing is posted. That it is☺"* Furthermore, she emphasized that *"people always are very different (different cultures, different personalities). Working in group is something that teaches you live and work productively with very different people, whom you know often little (I guess it is style of work in postmodern world). And you have to have good skills to work in group."*

In this group, when some group member was stuck on something else for some reason, the others would keep working on it and got it done on time. When talking about how she persuaded her partner to accept her thoughts, T3P3 said, *"I started to guild her carefully and carefully suggested her to put more things in diagram explaining why and how until from content point of view her diagram had about the same nodes as diagram that I made."* When persuasion did not work, she took advantage of file exchange feature through digital drop box in Blackboard to edit the diagram on her own rather than bothering her partner to ask for editing.

Online communication methods

T3P2 was very happy with this online learning environment because *"we all get to work at our own pace but we have the same deadline. And we all do work but we have someone to discuss it with and to check over our work."* T3P1 in her feedback used capital *"I LOVE IT! This learning environment really suits me because it gives me much more time to reflect on the subject material and my opinions of it."* T3P1 had nearly completed a masters program that was almost entirely done through various means of distance learning and that in her program she was very accustomed to collaborative projects done online.

In the third project, synchronous communication via chat room was required so that students could get some experience with different communication tools. After the first chat, the whole group preferred the threaded discussion because it allowed participants to reflect and research before responding and to give more in depth answers to questions and discussions. Concerning technical issues and time, asynchronous communication was more convenient to use because each person could participate at their own convenient time. For some ESL students, in particular, it allows them more time to read, think, understand, and respond, but also provided a chance to check the spelling and grammar of the sentences. T3P3's opinion about chatting was a good point for teaching and learning with synchronous communication skill: *"We don't know how to chat, because we don't listen to each other."* Indeed, the second chat was much better than the first one, indicating that some experience with the chatroom helps. Also, the chatting partner might also affect participation: students might concentrate more with the instructor than with peers. But as the project complexity increased, a face-to-face meeting was proposed because *"meeting might help organize things better than writing back and forth." This was their only meeting during the whole semester.*

Instruction

Paying attention to the instructional details was another key element to accomplishing the task, especially when the assignment became very complicated. In the first project, T3P2 first found out that T3P1 missed the requirement to give the definitions for the software evaluation criteria that she was in charge of. With the reminder, the summary turned out very successfully.

But in the third project, one part of the assignment was *"Each of you should write one portion of text to explain some aspect of your Visible Thinking concept map to other students who will need this help for studying."* T3P3 and T3P2 wrote down all the thoughts while T3P1 took a technical role to create the *Inspiration* concept map. By the end of the project, they

realized that writing was part of the requirement for the each member, and T3P1 went to ask about the instructor how they would be graded.

> T3P2: Remember when I said I thought there was more to the assignment, like we have to each write something more? I just looked and all that our assignment is, that every member in our group has to write a portion of the text that we put in the hypermedia. T3P1, I don't think that you wrote any (I could be wrong). But, I think that is okay. You spent a lot of time putting it all together and having to sort through what goes in there. So when you hand it in, I don't know how we explain to Dr. how we did it, but you might tell her that you put it together and T3P3 and I wrote things.
> T3P1: I just emailed the instructor earlier today about that. I was afraid of the same thing....I didn't really write anything.
> T3P3: I didn't notice this part too about "that everyone have [has] to write". Sorry about that, if we had been known that, we would organized [organize] work differently.
> T3P1: It sounds like she will just give us all credit for the project so we don't each have to write up an individual paper. Is that okay with you two? I feel like I didn't do as much as both of you so I understand if you don't want to do it that way. Whatever you two decide is fine with me.
> T3P3: It is okay with me that she is giving credit for all of us, anyway it is group work :)
> T3P2: I am fine with it also. Even though you didn't write anything you still did a lot of work. Good work!!

Student feedback

Project feedback did help the instructor to realize the real situation among the students during the project accomplishment process, especially when a problem happened. In the third project, T3P3 posted her worries about how there was not enough organization on how to conduct the project, and other two members did respond and agreed to clarify. And then there was a face-to-face meeting. Although I could tell there were difficulties in the students' collaboration, it was still hard to understand why and what it was. After reading one student's journal, I found that it did explain the reason and students' struggling, something which they did not show in the discussion postings.

> T3P3: I feel that we as group do not have any strategy. Everyone is doing something with no connections to others. I just put myself in a lot of reading, because it is my style before any project to find may resources and to go through them and then figure how artifact will look. And I was expecting that other members in our group doing the same, but from T3P1 big silence, and T3P2 "strange outlines" seem that we not communicating properly and just wasting energy. I got frustrated that we so not organized. I had already made a few posting with my findings and no conversation, no adequate reaction, I mean discussion s or debates.

Team Four (3 members, classified by LSI as two Divergent and One Accommodating, showed combination of Divergent and Accommodating from content analysis)

Collaboration

Students' active participation was an essential part in conducting a successful collaboration. Team Four in the first and second project had great difficulty in the whole group collaboration. Conflicts happened because the students had different learning preferences:

> T4P3: I am a start early and get it done kind of girl. I am a bit uptight about my assignments and projects. I am striving to keep my GPA up, so I work better on my own. I think I probably bug my group by always taking over and saying we need to get started and get things done. Maybe it is just the personalities in my group that don't mix well.

Indeed, T4P3 took an initiator role and made a lot of decisions during the entire course.

In the second project, T4P2 missed almost all the discussion about the project with her peers. From their project reflection, we could see their struggling about the collaboration:

> T4P2: I had a very hard time keeping up, not because it wasn't enough time to work, but because I completely forget about his [this] class during the week and by the time I remember, the work is due! I want to be a help to my team members. Now that we are down to three, I know I need to do more to keep the work load fair.
> T4P1: The collaborative process is getting better between T4P3 and I, but we are hearing less from T4P2 than before.
> T4P2: I think that our group's collaborative process was weaker for this second project than the first. I was able to physically meet with my group for the first project, but I wasn't for this one.
> T4P3: I could tell she was irritated that the work was already done, but the day its due is not the day to start. I sent out an email about the WebQuest and never heard from her.

At the same time, T4P2 wrote in her project feedback *"I felt since I was the only one in the classroom at the moment, that it would be more beneficial for me. But my group member chose the Elementary one before I could post, otherwise, I would like to have done the middle school directed WebQuest."* Obviously, there was not enough communication among the group members.

How to solve this problem? T4P2 in her feedback suggested *"I will suggest setting up a weekly meeting time for our group that way I have some reminder during the week to actually do*

my work for the class. It is hard to be in a group with people you do not see very often. Perhaps if we utilized the online chat option with Blackboard more I would be more of a part." T4P3 also suggested *"Our group just needs to make a point of logging on and collaborating EARLY and not just posting comments right before an assignment is due and just hoping someone summarizes the information and posts the assignment. I think it would be helpful to set up a schedule like everybody read and start discussion by this date, everybody have their part of the project done by the day…."*

Real discussion

Lack of real conversation and discussion was a barrier to collaborative learning. It was very interesting to see the students comment that their communication through the discussion board did not involve enough criticism and exchange of thoughts:

> T4P3: I wish our group was a little better about really having conversations and discussion instead of just posting comments. I am making it a goal to collaborate more with my group members.
> T4P1: my group members and I have been discussing the chapters very well so far. Each member answers the questions completely, but we are not very good about asking questions after the initial discussion.
> T4P3: I think we are talking a little more online, but we aren't discussion. We are just posting comments and going on. I wish we could set up a time to just chat and brainstorm idea. Technology is a bit out of my comfort zone, so I tend to doubt myself and ask many questions. However, it is improving as the semester continues.

Online communication methods

Different communication tools influenced students' collaborative learning attitudes and satisfaction. After struggling to collaborate through the discussion board, students got a chance to experience the instant chat through the lightweight chat room in Blackboard in the third project. The whole group had a very positive attitude toward lightweight chat, and the face-to-face meeting also helped this group with collaboration:

> T4P1: I thought we had a very good chat with each other. We asked more questions to each other and got instant feedback, which was lacking in earlier discussions. It was also good because we scheduled a time that worked for everybody and group members are then able to contribute more.

> T4P3: my group and I had a chat tonight. It was so fun and we got everything accomplished in just thirty minutes. We all agree we should have been using this earlier in the semester! It was so fun and we felt like we were a learning community! I feel that we were more productive and worked so well together than we have all semester.
> T4P3: we met at the catalyst media center to work on the project. Everyone showed up and brought ideas with them. We worked for a couple hours and I felt like we did a great job.
> T4P3: I enjoyed this project and did not feel so stressed out since everyone was helping out with it. I think we have finally achieved the idea of group work.

Team Five (4 members, classified by LSI as one Accommodating, one Assimilating one Divergent and one unknown, showed three Divergent from content analysis)

Learning environment

It took time for students to get familiar with the online learning environment and check their email and online discussion board regularly. Everyone in the group had different schedules and sometimes had trouble finding a time when they could all meet. It sometimes got frustrating when others in the group could not keep up. This group had lots of face-to-face meetings, with the result that I did not have much written data for this group; hence my descriptions are somewhat less in depth.

Organization

Clear and doable organization could improve students' responsibility to participate in the project. This group decided at the beginning of the project to take turns posting the final draft of each assignment and discussion. Another way they handled the project was to split up the work of each assignment and had everyone do certain parts, and then they posted their parts to the discussion board for others to read and comment on. Students believed that "*in this way, if someone disagreed with the posting, they could come to an agreement through discussion.*"

Hands-on activity

Hands-on activity, such as web page design did increase students' motivation for learning.

> T5P1: I would say that I enjoyed the TUTEE project much better than the first one because I was able to retain more of the information learned. It allowed me to add NEW skills to create the web page. This is something that I have wanted to learn for a long time but never had the time to do it.

Moreover, learning technology skills did boost students' confidence to integrate the technology into their own teaching and get familiar with their students' needs.

> T5P1: After reading the textbook and online articles, I have realized that there is a lot that I don't know yet. It seems that I get a handle on the technology integration part of teaching and then something new is added. I am fascinated by the opportunities there are to do so many different things with technology while teaching. I am really excited to get done with school and begin using some of these in a real classroom!

Face-to-face meeting

This group took advantage of all of them living in the same town that they had more face-to-face meetings than the other groups. Although one of students agreed that *"group discussion leads to a better understanding of the information, I feel that one of the very best ways to learn is from the peers and from trial and error,"* the students in this group still got frustrated with online collaboration because they expected everyone working together at the same time:

> T5P1: I think that if we are going to be required to work in groups with people we really don't know, we should just have a set class time in which to do this. It is such a headache getting everyone to do the work by the day it is due. The collaborative process is a good idea, but not for an online class.

The encouragement they received from their peers helped group members get through difficulties:

> T5P2: I spent all day on Saturday trying to contact my group members to get their completed parts and then spent all day Sunday creating the Webpage. I am also a huge perfectionist, so I spent a lot of time correcting what my team members had written. If it weren't for T5P3, I wouldn't have gotten through this project. He listened to my frustrations and kept me motivated throughout the entire weekend.

CHAPTER FIVE: DISCUSSION, IMPLICATIONS AND RECOMMENDATIONS

The purpose of this descriptive case study was to explore the participatory behaviors of students with different learning styles in a text-based computer-mediated communicative learning environment; whether students sometimes use a less preferred learning style in order to collaborate more effectively; and whether some group combinations in terms of learning styles seemed to work particularly well–or particularly poorly–in the collaborative learning environment. This chapter consists of 1) discussion, 2) implications, 3) what we learned, and 4) limitations of the study.

Research Questions:

I will analyze and discuss the findings in terms of my original research question and sub-questions or related areas of exploration:

Research question: How do groups made up of different combinations of learning styles engage in collaborative learning and what is the nature of the engagement?

> ***Sub-question a.*** What role do individual learning styles play in individuals' online collaboration behaviors?
>
> ***Sub-question b.*** Is the preferred learning style actually used in online discussion and collaboration even when another learning style might be more effective, or do students use less preferred but more effective learning styles?
>
> ***Sub-question c.*** Do some combinations of learning styles in a collaborative group seem to support collaboration better than other combinations?

I begin this discussion with sub-question a, and then move to sub-questions b and c. Taken in combination with the thick description in chapter 4, these three sub-questions provide an

answer to the main research question. I conclude with a discussion of possible instructional designs to address these findings.

Sub-Question a: What role do individual learning styles play in individuals' online collaboration behaviors?

Divergent learning style

In this case study, the students with Divergent learning style showed strong preference for the collaborative learning in this online learning environment. Based on the content analysis from the discussion postings, 68% of students' postings could be categorized into the Divergent learning style, and another 24% students' discussion postings fell into the Divergent learning style in the second rank. The discussion showed students' adaptive ability, brainstorming ability, social/interpersonal skills, and considered and thoughtful judgment during the discussion process. Kolb (1999) emphasized that people with Divergent learning style preferred working in groups to gather information, such as brainstorming sessions, listening with an open mind, and receiving personalized feedback. When students actively participated into the discussion, they brought up the ideas from their previous teaching or learning experiences, but at the same time, they needed other group members' suggestions and confirmation that the whole group could reach an agreement to accomplish the project. One example could be found in the discussion about "*using Tool as a lesson plan*" in Team Two:

> T2P1: Any ideas for using a TOOL as a lesson plan? Here are some key points…
> T2P3: Maybe we could write up the lesson T2P2 and I just completed for our goals. It is a Math Investigation Assignment where the student would be assessed on their creating an excel worksheet representing their data and then putting it into a graph representation. What do you think?
> T2P4: I think that would be a great idea to create a lesson teaching the students to create a graph in excel. Math would be the easiest subject to integrate it into.
> T2P2: I'm up for that.

In this case study, students with Diverging learning style combined Concrete Experience with Reflective Observation, were able to view concrete situations from many different perspectives. Asynchronous communication through the discussion board and emails provided the chance for students to think rather than take immediate action, and to have more time to combine experience with reflection.

> T3P1: Threaded discussion allows us to reflect and research before responding and to give more in dept answers to questions and discussions. it is better for international students because they have time and tools to check their spelling and grammar and longer to read and understand the postings.

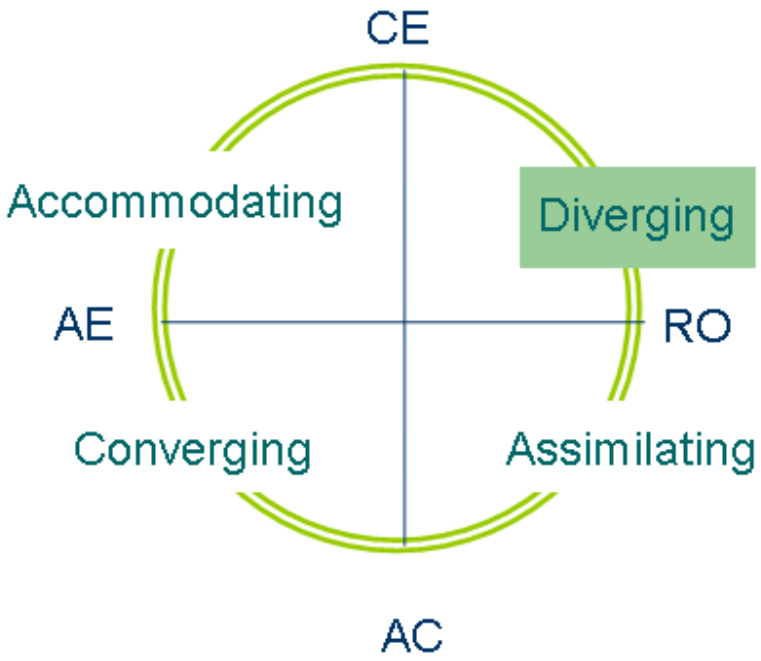

Figure 18. Divergent Learning Style (based on Kolb, 1984).

Convergent learning style

We also saw in this case study that the online collaborative learning environment promoted students' Convergent and Accommodating learning styles that these tow styles were particularly important when it came to being successful in this course. This online collaborative learning environment was designed as learner-centered. The students were encouraged to solve problems

and make decisions during the collaboration and they also needed to deal with practical applications like the WebQuest project, web page design, and “artifact” design All these features challenged students’ Convergent learning style (a style that combines Active Experimentation and Abstract Conceptualization), a style in which one prefers to deal with technical tasks, problems and practical applications.

None of the students self-evaluated themselves as having a Convergent learning style, but from the content analysis of the discussion postings, students’ postings did indicate their own analyzing ability, logical/systematical thinking, practical ideas, problem solving skills and decision making ability. Twenty-two percent of students’ postings showed dominant Convergent learning style characteristics, and another 35% of students’ postings indicated Convergent as their second used learning style.

With the tremendous requirement for students to take ownership of their work in the online collaborative learning environment, students with strong background knowledge, technology skills, teaching experience, and high motivation to learn promoted their Convergent learning style to accomplish the project. They always took initiative for the whole project or discussion, and further explained the assignment when other members were confused and came up with practical ideas or suggestions to divide the work for the each member or to solve problems. With strong technology skills, they taught other members to use the various technologies and posted some tutorials online. By reminding others of the deadline, they usually pushed the discussion process to get the project done. Decision-making following the higher-order thinking became a key to reach the project deadline. In the Team One, T1P1 had very strong technology skills that augmented her confidence to take a central role for the three projects. She took care of all technology questions and led the whole group to experience synchronous communication

through use of the lightweight chat in Blackboard. Her peers commented in the feedback, *"T1P1 was the real driving force though, because she has the technology competence to take our crude suggestions/attempt and really create a quality product."* In Team Three, T3P1 and T3P3 both took a leadership role: T3P1 tried to get the project done and also she had teaching experience, while T3P3 was highly motivated to learn more as a doctoral student and explored more thinking and in-depth discussion about the discussion topics. Her group members commented that *"T3P3 is a very hard worker, and really wants to make sure everything is right. I really appreciate her point of view and the ability to look at everything from a different viewpoint than I'm used to. I have learned a lot from her."*

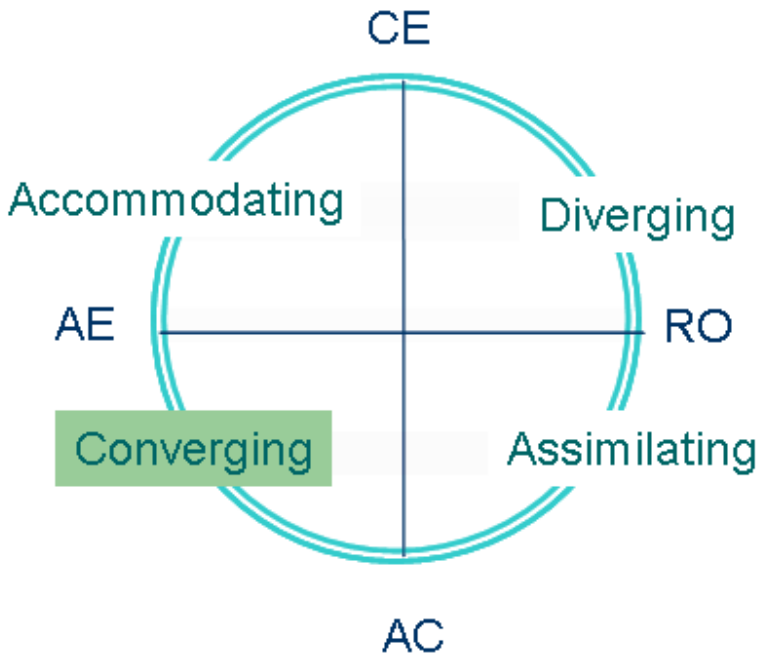

Figure 19. Convergent Learning Style (based on Kolb, 1984).

Accommodating learning style

In addition, this project-based learning environment challenged student's Accommodating learning style which combined Active Experimentation with Concrete Experience, in that people with this learning style prefer to learn primarily from "hands-on" experience. Twenty-four percent of students' postings fell into the Accommodating learning style but only one student's self-evaluation was consistent with the content analysis results in this category. There are two kinds of situation that cause students to fit in this category: one is for those who actually were in charge of the hands-on activities, and contributed their thoughts and suggestions more actively, which required more feedback from their group members (for instance, T2P1 who had the very high posts in Accommodating category actually took a leadership in Team Two); the other is for those who lacked of confidence and depended on others' feedback and suggestions. Hands-on activity could encourage students use their Accommodating learning style by involving them to set up goals, to create the project, and to test out different approaches when they tried to complete the project. According to Kolb (1999), people with Accommodating learning style like to carry out plans and involve themselves in new and challenging experiences (p. 7).

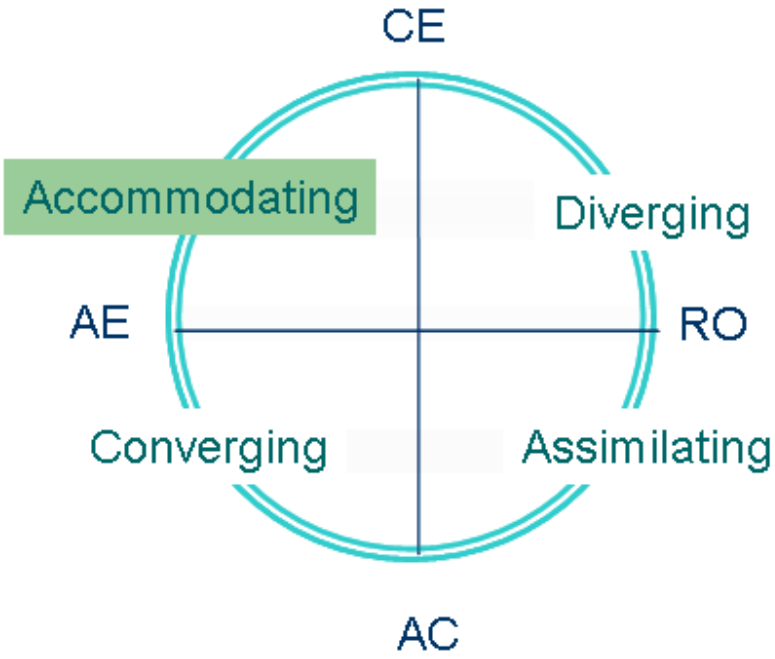

Figure 20. Accommodating Learning Style (based on Kolb, 1984).

Assimilating learning style

Students with Assimilating learning style are less focused on people and more interested in abstract ideas and concepts, and also prefer lectures. Lecture is not suitable in this online collaborative learning environment in this case study, and students needed to put in considerable cognitive effort to learn the abstract ideas. Some preferred not to put in this kind of effort. Those with the Assimilating learning style did not show a positive attitude toward this online collaborative learning environment. Two students who self-evaluated themselves as Assimilating actually showed Divergent learning style in their discussion postings analysis. For those who lack a strong motivation, an instructor's intervention is a powerful tool in the stimulus of student work. In this study, the course requirement that students participate in the discussion might have changed these two students' attitude and behavior in terms of the learning style. In other words,

the instructions for the course may have motivated (or required) students to use a less comfortable learning style.

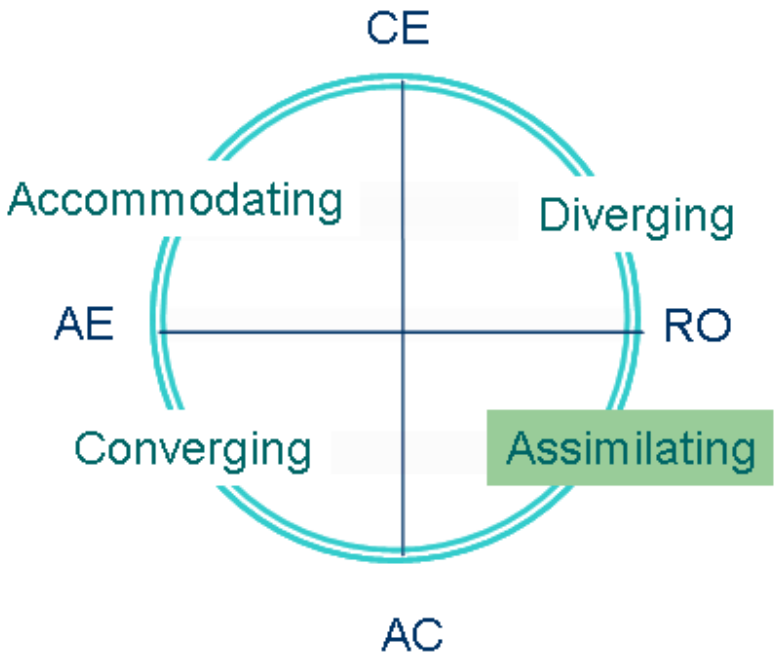

Figure 21. Assimilating Learning Style (based on Kolb, 1984).

Sub-question b: Is the preferred learning style actually used in online discussion and collaboration even when another learning style might be more effective, or do students use less preferred but more effective learning styles?

An interesting phenomenon I noticed was that students' self-evaluation kite shape matched their different behaviors in the discussion process consistently: those who took very obvious initiative and a leadership role, for instance, students T1P1, T2P1, T3P1, T4P3 and T5P3, had kite shapes close to the learning mode Concrete Experience "feeling" (see Figure 22).

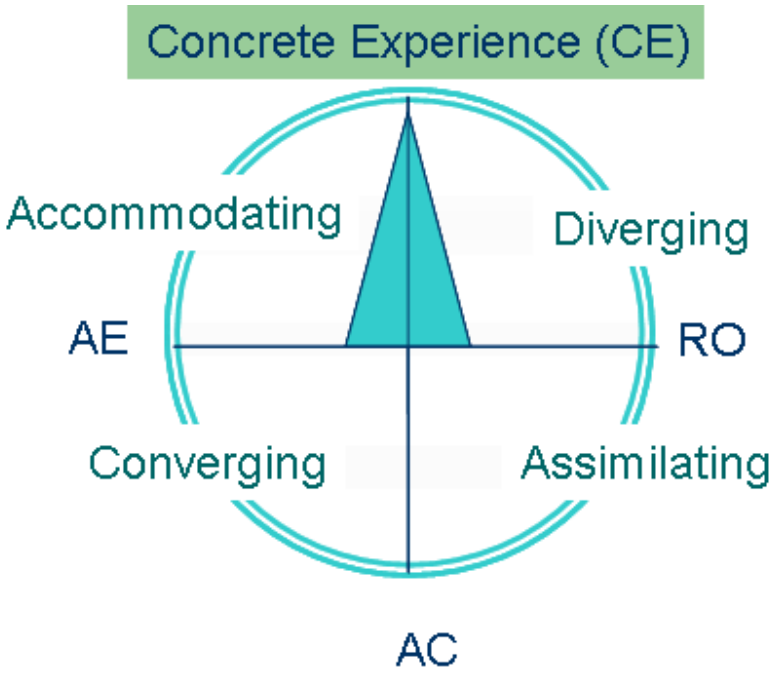

Figure 22. Kite Shape Close to Concrete Experience Mode.

Others who were “watching” and showed more supportive role had their kite shape was close to the Reflective Observation, for example, student T1P3, T2P4, T3P2, and T4P1 (see Figure 23).

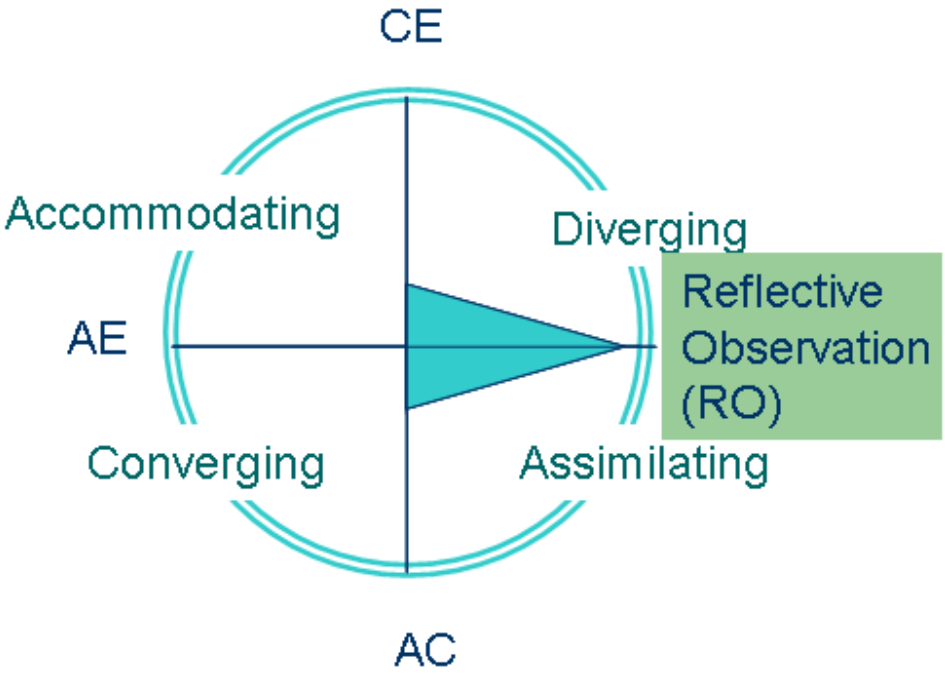

Figure 23. Kite Shape Close to Reflective Observation Mode.

Those who usually took both leadership role and supporting role and were comfortable with a variety of learning modes, had their kite shape balanced along two or more dimensions of the learning cycles, for instance, student T1P4, T2P2, and T5P1 (see Figure 24).

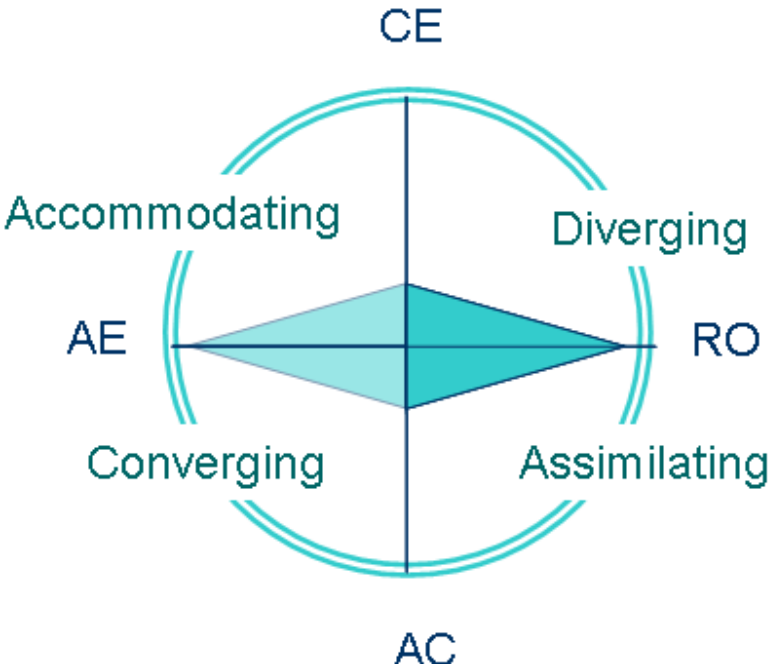

Figure 24. Kite Shape Balanced Along Two or More Modes.

Comparing students' self-evaluated learning style results and content analysis results from the discussion postings, this case study also showed consistency with the literature, which indicated that a student's learning style can, in fact, be altered and affected through the external conditions set up in the environment (Cohen, 2001). Students with previous experience, related technology skills, and high motivation *can* take a leadership role no matter whether their original learning style would lead them to prefer it or not.

Sub-question c: Do some combination of learning styles in a collaborative group seem to support collaboration better than other combinations?

Based on the students' learning style self-evaluations, among the five teams, students' learning style combinations were quite different: (1) Team One consisted of four Divergent learning styles. (2) Team Two consisted of three Divergent learning style members and one with

Assimilating learning style. (3) Team Three consisted of two Divergent learning styles and one Accommodating learning style. (4) Team Four consisted of two with Divergent learning style and one with Accommodating learning style; and (5) Team Five consisted of one Divergent learning style, one Assimilating learning style and one Accommodating learning style (the fourth student's self-evaluation is missing). Figure 25 shows this visually.

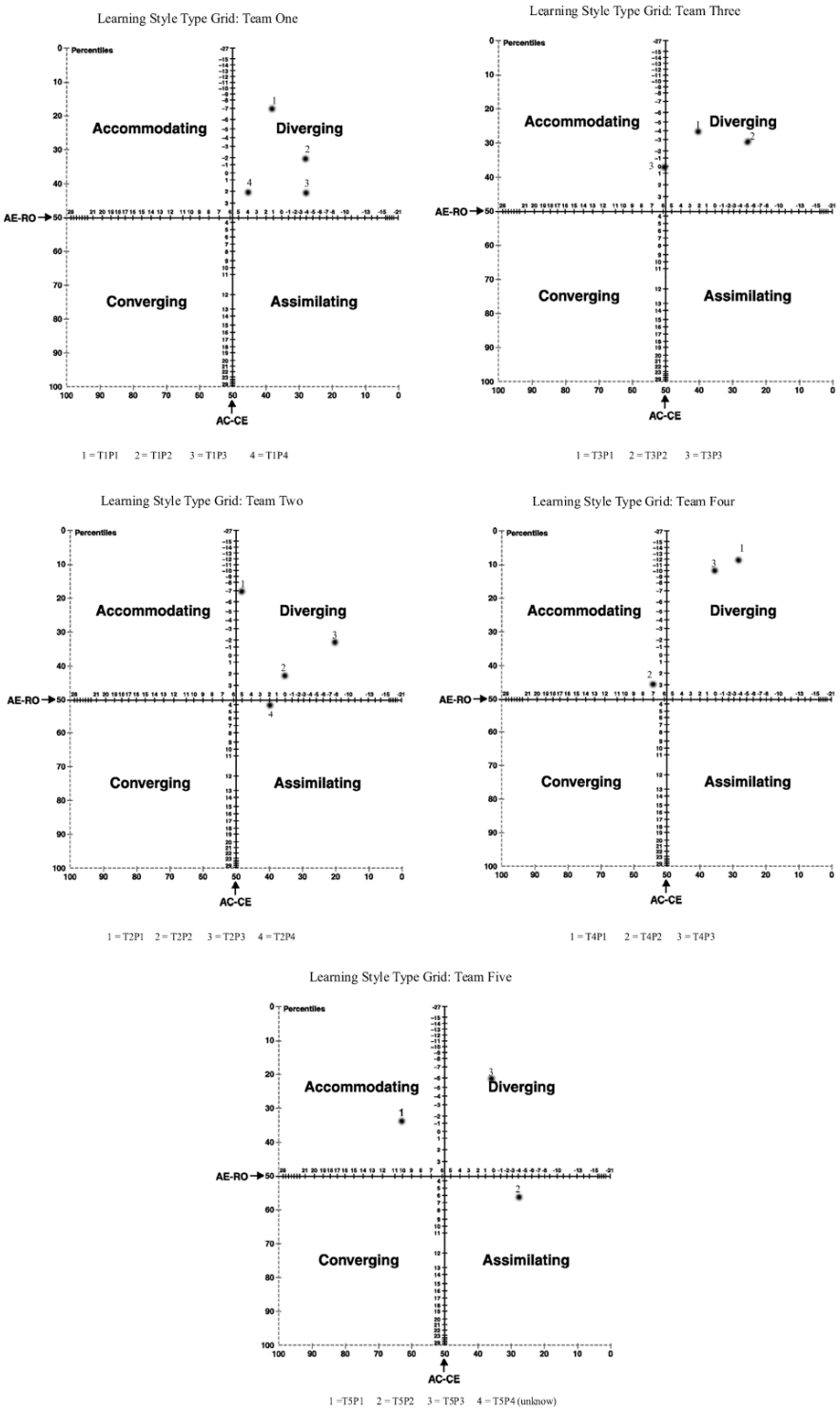

Figure 25. Five Teams' Learning Style Type Grid.

Due to the incompleteness of students' discussion postings, it is hard to make a conclusion as to whether certain learning style combinations functioned together better than others in this case study. Students were allowed to meet face-to-face if they chose, with the result that those particular discussions could not be recorded for the analysis. The Team Five met face-to-face and finished the second and third projects without posting any discussion online. The Team Two split into two subgroups so that the subgroups could meet face-to-face. Discussions within those subgroups were not recorded either. Team Four students just posted their comments and summaries and there was not too much discussion and questioning going on, at least that was visible to the researcher. Two teams– Team One and Team Three– posted their almost entire conversation online. Students from these two teams self-evaluated themselves as having a Divergent learning style, except for one student T3P3 who was Accommodating learning style. However, from the content analysis of actual behavior, that is their discussion postings, these two teams had Divergent, Convergent, and Accommodating three learning styles combination in the same team. The other groups either lacked Accommodating learning style or Convergent learning style (see Figure 26).

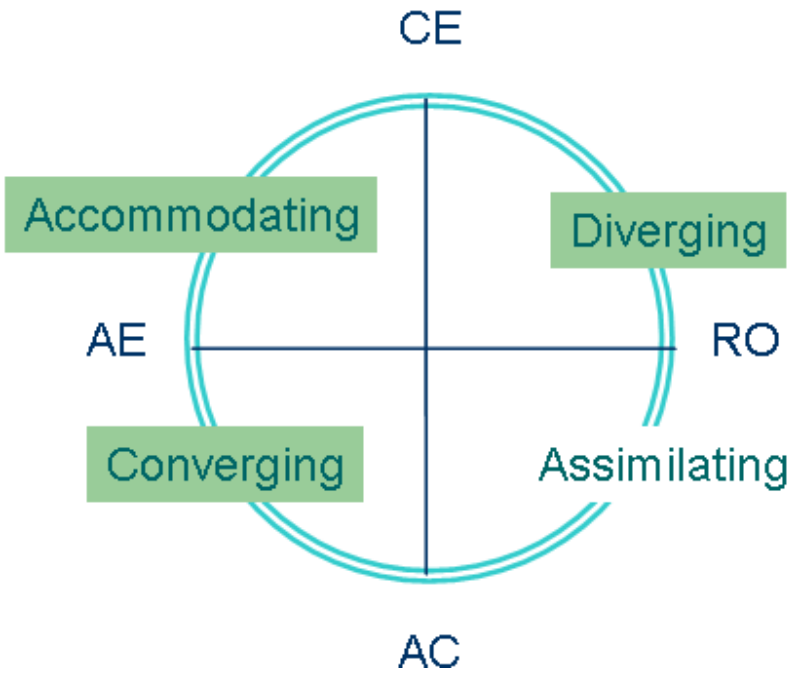

Figure 26. Learning Style Combinations in Team One and Team Three.

In these two teams, students with a Convergent learning style took a strong leadership role: the Converger on Team One was T1P1, and the one on Team Three was T3P1. The Convergers started organizing the project and dividing the work among everyone, and then actively participated in the discussion to finalize the summary. Each was the decision-maker in the group. At the same time, students with Divergent learning style showed interpersonal skills in these two teams. Student T3P2 and T1P2, T1P4 had lots of social posts to connect the group members. Students with Accommodating learning style in Team One (T1P3) and Team Three (T3P3) showed a very strong preference to work with other people.

Group collaboration behaviors might be different from student to student due to the students' different motivation levels for the learning process, at least in this particular course. Students in Team Three consisted of one doctoral student, one masters student and one undergraduate student. They had different learning purposes: T3P3 (doctoral student) wanted to

learn everything and was highly motivated to read more and explore more on the topics, while T3P1 (masters student) wanted like to work on projects which she could use in her own classroom and also would like to get it done quickly by following the instructions. This difference caused some conflicts and disagreements in the group discussion. Another group, Team One, consisted of four in-service teachers who shared similar interests and motivation in how to integrate technology into the classroom, so that they did not have the conflicts that happened in the Team Three.

Due to the complete discussion posts and project reflections, I could fully observe that these two teams (Team One and Team Three) experienced conflicts and how they reached agreement: firstly, all the members contributed their opinions, experience, needs, skills and strengths to the group without being afraid of disagreement. Indeed, discussion in these two groups indicated students' strong motivation to explore and construct new knowledge, and interest in sharing their own teaching experiences and trying to find a solution for their classroom problems. The willingness to express disagreement enhanced the learning in both groups. Negotiation and explanation back and forth among group members did open themselves those differences so that everyone learned from each other. Although there was compromise to reach agreement for the final submission, students did learn from different perspectives. Moreover, these two groups had more posts of chit chatting, greetings, and support than other groups.

By comparing the content analysis of students' discussion posts over the three projects, the numbers of student posts in different categories are consistent in terms of learning style characteristics. That is to say, there is not a big difference in students' behaviors over the three projects. For instance, student T1P1 had the most posts that were Convergent in style over all

three projects, while T1P3 had the most posts that were Accommodating in style over all three projects. This phenomenon could easily be seen in Team Three: student T3P1 had the most posts that indicated Convergent in style, student T3P2 had the most in Divergent learning style, and student T3P3 had the most in Accommodating style over all three projects, although her posts that were Convergent in style increased on the third project due to the high motivation.

With only two teams' data complete enough for a thorough analysis, I am reluctant to conclude anything about which are the most successful combinations of learning styles in this case study. However, the findings confirmed the previous research that learning power is increased and problems are solved more effectively by working with others who have different learning styles. Although groups made up of different learning styles more prone to difficulties, students would experience the learning cycle more fully with those who have learning styles that are different from their own. And learning flexibility could be increased to help students cope with all kinds of challenges (Kolb, 1984).

Implications

Based on the analysis of available data, some implications may be considered to improve this computer-mediated collaborative learning environment in terms of a commitment of learning through doing, the engagement of learners in collaborative learning, and the shift of the instructor's role from authority and chief source of information to facilitator and resource guide. In this part, I refer to Kolb's Experiential Learning Theory (ELT), especially the six propositions that built the theory: 1) learning is best conceived as a process, not in terms of outcomes; 2) all learning is relearning; 3) learning requires the resolution of conflicts between dialectically opposed modes of adaptation to the world; 4) learning is a holistic process of adaptation to the world; 5) learning results from synergetic transactions between the person and the environment; and 6) learning is the process of creating knowledge (Kolb, 1984, p25-38).

I used this theory and the data gathered to see if there were any possible conclusions we might draw to improve the instructional design of an online course such as *Learning Technologies*.

Instruction

Bruner pointed out that "Knowing is a process not a product" (1966, p.72). The purpose of education from this point of view becomes to motivate student inquiry and skill mastery, not to force learners to memorize a body of knowledge. The design of instruction becomes challenging with this purpose. Both individual and group work was used in the design of assignments for the course studied in this research, and with the increase of the difficulty and complexity over the three projects, the nature of group tasks became an important part of the collaborative learning process.

In this case, the first project required students to read the textbook and related articles and to discuss the use of technology as a "tutor" in order for students to understand the basic concepts, key themes, and issues for using technology in the classroom. An individual and group software review section of Project One challenged students' critical thinking and provided the opportunity for the students to become familiar with various educational software types, criteria for evaluating software, software and technology resources in their schools or communities, and classroom utilization. The volume of students' discussion postings was comparatively small and responses were not very active. One group of students had comments like this:

> T4P3: I wish our group was a little better about really having conversations and discussion instead of just posting comments. I am making it a goal to collaborate more with my group members.
> T4P1: my group members and I have been discussing the chapters very well so far. Each member answers the questions completely, but we are not very good about asking questions after the initial discussion.
> T4P3: I think we are talking a little more online, but we aren't discussion. We are just posting comments and going on. I wish we could set up a time to just chat and brainstorm idea.

Hands-on activity did highly stimulate students' learning and participation. The second project required students to learn how to create a simple web page and after reading related articles and viewing and participating in WebQuests, they were required to create their own WebQuest project. One extra credit point was even offered them to participate into the WebQuest contest by submitting their WebQuest to a website for consideration. The statistics report from Blackboard showed that students' hit numbers jumped from the 1,500 or so to 6,000 or so as they moved from Project One to Project Two. And the group work in this project increased when students had to each take different roles to complete the WebQuest Project, either sharing the writing, or sharing the creation of the quest. Some students' comments about this part of the project were very inspiring:

> T1P1: I liked it that you made us find a skill that we needed to work on because it seriously had been since high school since I had used a database. So I am glad I got to do that…. Now back to the webquest, this was interesting. I would have to say that I knew nothing of webquests before now. I totally enjoyed this part of the project.
>
> T3P1: this was a very cool assignment. I have done web quests with my students before, but have never made one myself.
>
> T2P4: I really enjoyed the project even thought it was a semi-stressful assignment. I learned many new skills about how to make a webquest, specifically the software out there to assist. I enjoy using webquests with my 5th graders in science and I know I feel more confident in creating some myself.
>
> T1P3: Now we may have a web quest that can fit into our curriculum. We actually completed an assignment that will actually benefit our teaching….I want to do more although I am still going to have the help of my curriculum tech.
>
> T2P3: I have never done anything like a webpage or a webquest ever before. In fact, I did not even know what a webquest was before taking this course. I have learned quite a bit as far as what a webquest is and what a webquest is used for. I was frustrated however by the software choices I had available. I wish there would have been more options listed for us to use for our webquests….i am now more motivated to fine better software and make another webquest that would visually meet my needs.
>
> T4P3: I had so much fun learning to make a web page. I loved making the web quest. In a million years, I never thought I would learn to program anything. I had never heard of a web quest before. I feel that I am learning things I can actually implement in my classroom.

Different strategies integrated into the instructional design could meet the course content and students' needs. The third project was a project-based learning task in which students needed to explore cognitive and communication tools in the context of several constructivist approaches to integrating technology into teaching and learning. Each of the five teams was responsible for researching one constructivist approach and putting together a technology project or "artifact" that would teach the other four groups about that approach to teaching/learning with technology. Students needed to do some research with the help of some external resources provided by the instructor, and they actually learned about each approach well enough to teach others. Meanwhile they were required to present the concept visually and informatively. Each group's presentation would be the other groups' learning resource for one of the four essay questions

making up their final exam, so it was extremely important to everyone to do this well and responsibly because other people's grades would be affected. Synchronous communication through the lightweight chat and face-to-face meetings had been encouraged in this project due to the complexity of the project. And students were required to keep a journal for the whole project. Further discussion about these two communication skills will be presented in the following section. Some students' comments were very encouraging for the journal strategy:

> T3P1: We are now posted to the web and it looks great. I guess it was worth all of the effort and frustration. Overall, I think I learned A LOT more than I would have had this been an individual assignment. Now that the project is done it is hard to look back and see how frustrated I was, but I guess that's why we keep journals, to see how our feelings change as we grow and change!:)

Kolb also highlights that the process of learning requires the resolution of conflicts between dialectically opposed modes (Kolb, 1984, p. 29). That is to say, new knowledge, skills, or attitudes are achieved through confrontation among four modes of experiential learning. Learners need four different kinds of abilities and continuously choose which set of learning abilities they will bring to bear in any specific learning situation. With this theoretical explanation in mind, it was not hard to see students in a learning process, switching from actor to observer, and from specific involvement to general analytic detachment. This could be the reason that students' self-evaluated learning style results were not consistent with content analysis results from the discussion postings. Learning often requires that we use abilities, and learning styles, that do not come easy to us. This stretches us, and increases our tools/strategies for new learning situations.

Students in this case study who lacked of teaching experience or technology skills tended to take a supportive role instead of leadership role during the projects, while those who had strong background knowledge would become leaders:

> T1P4: I know nothing about either concept mapping or inspiration so guess I had better do a lot more looking.

> T1P1: I feel that we all started out this project equally contributing but soon realizing that I would help the most in this project when it got down to making web pages…

Students were highly motivated to explore more learning like T3P3 also showed very strong leadership in the discussion process:

> T3P3: both of my partners take things a little bit simpler as I do… I tried to bring new issues about MI and Bloom's taxonomy to our software category, but nobody kept discussion about that…
> T3P3: she said that we do not have make things complicated, but to make artifact for others to teach it has to have more concepts and resources as work with that. I just started to guide her carefully and carefully suggested her to put more things in diagram explaining why and how until from content point of view her diagram had about the same nodes as diagram that I made…. When T3P2 drove me back home she offered to help me with writing and I suggested her to write about hypermedia structure and nodes and gave her a book…

In addition, it has been found that any group task must be a genuine group task, and that it must include enough space for negotiation and argumentation in order to serve as a starting point for high-level learning (Arvaja et al., 2000; Schwartz, 1995; Dillenbourg, 1999). This issue had been considered when the instructor designed the course instruction.

> The third project assignment: Each group is to research their driving question(s), find definitions, examples, think about how these approaches can be used for teaching/learning with technology. It will involve research for understanding, then conversation among yourselves, and then have an online Chat meeting with the instructor as you begin to plan your project. Then you will need to be sure to think about what you have learned so that you can teach it to others through an e-artifact (assignment).

Before the second project, the instructor posted one announcement about *"hints on how to do a collaborative online discussion."* This announcement was intended to encourage student to organize their collaboration more efficiently and to participate more actively. Strategies such as starting early, choosing a moderator for the discussion from the group, and deciding on a framework for the discussion, were very helpful.

Asynchronous and Synchronous Communications

In Kolb's ELT, learning is a continuous process grounded in experience. Computer-Mediated Communication (CMC) through asynchronous and synchronous communications

allowed learners the freedom to develop their own learning continuously. The threaded discussion board allowed students bring their own beliefs, theories, and experiences into the group discussion platform first, and then with other students' responses and discussion, they could examine and test those theories and then integrate the new, more refined ideas into their individual knowledge systems. The learning process will be facilitated by this interaction.

At the beginning of the course, students needed time to get familiar with the online learning environment, especially learning to check the discussion board on a regular basis. For the first project, some students did complain about using the discussion board instead of face-to-face meeting:

> T1P3: I have enjoyed talking with my group members unfortunately I've lost their faces because we met once for about five minutes and since have communicated only through email. I think that more face-to-face time with instructors present would be beneficial.
>
> T1P4: The collaborative process has been a difficult to accomplish through computer discussion because what was agreed upon by the group was disregarded. And in terms of time, online collaboration was inefficient and caused our task to take agonizingly forever to complete because "wait" for other s to respond to the comment or to respond to other comments via asynchronies communication. Face-to-face meeting one per week has even been suggested.

Some group members even proposed chat instead of the discussion board:

> T4P2: I will suggest setting up a weekly meeting time for our group that way I have some reminder during the week to actually do my work for the class. It is hard to be in a group with people you do not see very often. Perhaps if we utilized the online chat option with Blackboard more I would be more of a part.

With the belief of *"it is improving as the semester continues,"* students' attitudes changed with the familiarity of the skills.

Synchronous communication had been encouraged for increasing students' interaction and instant problem solving. But only one group expressed their preference for this method:

> T4P1: I thought we had a very good chat with each other. We asked more questions to each other and got instant feedback, which was lacking in earlier discussions. It was also good because we scheduled a time that worked for everybody and group members are then able to contribute more.
> T4P3: my group and I had a chat tonight. It was so fun and we got everything accomplished in just thirty minutes. We all agree we should have been using this earlier in the semester! It was so fun and we felt like we were a learning community! I feel that we were more productive and worked so well together than we have all semester.

Most of the students complained that the first time they tried it, the instant chat was tough and no fun:

> T1P4: The chat room was really tough! I cannot think quick enough before someone else responded and then it seemed like I was conversing with someone else instead of the person I thought I was.
>
> T1P3: The chat was not fun. I couldn't think long enough to complete a sentence before we were off on another question.
>
> T3P1: Well, after finishing our chat, I am just feeling stressed. I just don't think a chat is for me. I stress about being on the computer at the right time and if it's going to work. I really prefer to use the blackboard discussion board.
>
> T1P1: I was thinking that this chat room would be cool but … I type way too fast compared to my other teammates so it was kind of boring. I think we would've had a better discussion using the discussion board.

The reason for non-satisfaction with the chatting could be explained that students who did not have enough chat skills and felt overwhelmed, and also the student T3P3's comment was reasonable *"We don't know how to chat, because we don't listen to each other."* By the second chat with the instructor, students had had some experience with the chatting, and did not feel as stressed with this type of communication any more. They expressed the relief from the confusion. T3P3's commented that *"maybe we pay more attention to the instructor."* Another student T1P4 pointed out that *"I did not like it with four people, two would be fun though,"* and *"The chat with Dr. was easier, she used our initials to make sure we knew who she was responding to. Something so simple and it helped so much!"* In fact, it would be beneficial that synchronous communication skills would be introduced into the online class from the beginning of the semester. In this way, students' confidence to use the instant messenger chat would be improved and they would have more options to communicate and collaborate with each other.

Indeed, asynchronous and synchronous communication and even face-to-face meetings should be encouraged to increase student collaboration. Multiple options could improve students'

motivation to participate into the discussion in terms of convenience and flexibility, and thus, eventually enhance the quality of the interaction.

Collaboration

Kolb's Experiential Learning Theory (ELT) emphasized one of characteristics of the learning is that learning involves transactions between the person and the environment. The traditional educational process takes learning as a primarily personal, internal process requiring only the limited environment of books, teacher, and classroom. However, Kolb views learning as an active, self-directed process in which individuals exchange their needs, values, and behavior patterns in the group setting (Kolb, 1984, p. 34-36). Individuals in collaborative learning have to express and clarify their own thoughts, which increase individuals' metacognitive awareness of their own thinking, and give them a better understanding of each other's perspectives. The conditions for conducting productive group work require that the participants have a shared knowledge base, with common ground for mutual understanding, and also involvement and motivation to work towards completion of the task.

> T5P1: Group discussion that led to a better understanding of the information. I feel that one of the very best ways to learn is from your peers and from trial and error. Class discussion is just that, everyone sharing their knowledge with the rest in order to get the complete picture.

Peer feedback turned out to be very educational to enhance the students' learning. In terms of successful collaboration, students were expected to actively help and support one another. Members shared resources and support and encouraged each other's effort to learn. In this case study, students not only learned within the group, they also collaborated in the whole class by giving the feedback to the other groups' projects.

> T2P4: the feedback was very helpful. We all had slightly different views on what we thought the final webquest should look like so it was nice to hear outside opinions. I wasn't a fan of the black background on ours so it was encouraging to know that I hadn't lost my mind, but others found it hard to read too.

> T4P3: I loved the group feedback part of the web quest project. I was a bit nervous about it, because our webquest was very basic and simple. We included the requirement, but some of the others were so elaborate. The peers were very nice and helpful about it. I went back and fixed the tings they noticed. It motivated me to improve our webquest. I would love to continue research on webquest and learn how to make ours a little more fancy.

Resolution of conflicts could promote productive learning. In Kolb's ELT, learning involves transactions between the person and the environment (Kolb, 1984, p34). Learning experience is a transactional process in which the members negotiate as each attempts to influence or control the stream of events and to satisfy their personal needs (Bradford, 1964, p. 192).

By the end of each project, students were required to submit a project reflection about their own individual and group contributions and difficulties. This reflection was intended to help the instructor understand the students' needs so that the course design could be improved for the next project or for a future similar course. It did clearly reflect the students' struggling during the collaboration and how they solved those problems such as: time conflicts, disagreement, different expectation, and so on.

One interesting observation is that none of the students posted their complaints in any discussion posts when the collaboration process was not going well. What we could see in the discussion postings were pretty much encouragement, agreement, and appreciation. In this way, all the members could work together and get the project done. By reading the reflections, however, we could tell that there had been conflicts concerned with responsibilities and the division of tasks or with differences in understanding the assignments and motivation. Students did try different strategies to solve their problems and also to adapt to the other group members.

> T3P3: I think, I learned not only accept somebody ideas even if I didn't like them, but make suggestions and changes more bravely.

On the other hand, however, not only the environment shaped the students' participation behavior, but also the students' behavior also changed the learning environment. The students who were highly motivated and actively contributed into the discussion did improve the collaborative interaction among the group members.

What We Learned from This Case Study

Different learning styles led to different participation behaviors in the online collaborative learning environment. Students with the Convergent learning style preference had the most positive attitude toward the online learning, and those with the Assimilating learning style preference had least positive attitude toward the online learning.

The students who preferred Concrete Experience "feeling" learning mode took more initiative and a leadership role while the students who preferred Reflective Observation "watching" learning mode were more supportive in the collaboration. The students who balanced their learning modes usually balanced their behaviors in the collaboration.

The external environment can enhance all of the learning styles. The collaborative learning environment requires students' active participation, especially in this particular course that was the subject of this case study, where all students were required to post their own opinions and also discuss with their group members in order to put together the final summary or project products. The project deadline and the instructional requirements forced students' contributions to the discussion even if they were not comfortable with it. In this way, some students might have changed their preferred ways of learning to adapt to the demands of the learning environment.

Students' strong background knowledge, technology skills and high motivation enhanced their leadership in the collaboration, while the lack of the confidence and sense of responsibility tended to direct students' behavior away from the participation and toward observation.

In order to provide more opportunities for quality interaction and thus improve commitment to the group, both asynchronous and synchronous communication channels need be open for the students and also students need to be encouraged to take advantage of these tools. Face-to-face meetings should not only be allowed but in fact encouraged when the project becomes complex. Students' social skills and behaviors need to be improved to facilitate the productivity of the group.

Using technology is quite challenging in an online course. Students need support to solve all kinds of technical questions. But once they have experience at least once with a given technology, they became more confident to use it, and even interested in exploring all kinds of possibilities. For example, one group even thought about using the digital drop box to exchange the files back and forth. The concern about using a different Course Management System (CMS) for example from Blackboard to K-State online, could be reduced once students could have access to clear instruction and prompt responses about using it.

Structure and dialogue are the components of an online transaction that can reduce the distance between students and teachers (Moore, 1973). Structure refers to the overall design of the course, while dialogue can be described as the learner-teacher/learner-learner interaction in a distance course. According to Moore (1973), when dialogue increases and structure decreases, transactional distance decreases; or when structure increases, transactional distance increases and dialogue decreases. In this case study, structure also influenced interaction. For example, requiring students to engage in discussions and collaborate on projects increased interaction in

the course. In this way, the increased structure led to more dialogue and interaction. Besides, when students cannot meet face-to-face, they are more likely to participate in the online portion of the course since that is their only other option.

Limitation of the Study

The limitation of this study is large. Students' communication beyond the discussion postings and the archived chat could not be traced and recorded completely. This is a case study of an online course in which all the discussion was based on the specific course environment. The research results are not intended to be generalized, but merely to suggest possibilities.

The formation of student groups was based on students' own choice that there was no any control or arrangement in terms of learning style combinations. Students' background knowledge, online learning environment and students' motivation had an essential influence on their behaviors that is confounded with, that is, inseparable from, the observation results from the learning styles.

Recommendation for Future Course Design

One of the principles of Androgogy for adults (Knowles et al., 1998) pointed out that the adults prefer a problem solving orientation in learning; In particular, they learn better when knowledge is presented in real-life context. It should be very helpful, then when a course project is designed stressing ownership of the learning process by learners, experiential learning and a problem-solving approach to learning. In this case, real-life problems for those in-service teachers could be the ones which integrate technology into their own classroom to enhance the students' learning, collaboratively and individually.

Synchronous communication channels such as chat room and instant messenger could be encouraged from the beginning of the course, and other forms of communication channel, such as web blog or newsgroup via Internet, could be introduced into the classroom to keep all learners of a learning group up to date.

The instructor' requirements, feedback, and comments could enhance students' participation by giving clear instructions. Meanwhile, students should be encouraged to describe the reasoning behind ideas they put forward, which could extend the discussion.

Students' learning preferences could be discussed at the beginning of the course so that group members could understand each other better, and adjust themselves to the course requirements and group learning environment. Learning to confront the conflict is one of the elements to enhance the learning through negotiating with others, and the instruction could encourage students construct their own knowledge and also provide the chance to integrate each other's opinions.

Recommendations for Future Research

Here are some suggestions for further research on learning styles and collaboration in an online learning environment:

- A comparison study could be done on a group of students who uses asynchronous communication and those who use a synchronous communication approach. In the case reported in this research, we could not retain the complete archived chat for the research because the students started using synchronous communication only on the third project, and most of them failed to archive the chat on the first chat assignment. It would be interesting to see whether the students' learning styles influence students' behavior

using these two different tools.

- Another comparison study could be conducted looking at the changes in learning styles that students use when collaborating online, over an extended period of time through a series of projects. I had observed the discussion in the two teams, and the results did show consistency in terms of learning style categories. But the two teams' data is not enough. A future study could distribute Kolb's LSI after each project to see whether students' change their perspective or preference or at least change their behavior and are able to use a more productive style of collaborating after experiencing various levels of the collaborative learning. Due to their face-to-face meetings, two teams' online discussion postings were missing in this case, which diminished the possibility of research on this topic.
- It would be interesting to conduct the research to see whether kite shapes could be a predictor of students' collaborative behaviors. In this study, students in different kite shape did show the different collaborative behaviors. But the sample size was limited, and this topic will require further study to see whether there is a potential for a relationship.
- It would be useful to explore the instructor's role in this collaboration-oriented online course from the point of view of the relationship between the instructor's teaching style and students' learning style.

Conclusion

In closing, as educators, we must keep in mind that people are so different. The instructional strategies should be concerned about these differences, and we should explore an ideal online learning environment that encourages learning through feeling and thinking, learning

through acting and reflecting; that bridges the connection between learners' interests, experiences and motivation and learning effectiveness; and that promotes learners' responsibility for their own learning from experience and collaboration through communication.

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APPENDIX A: Student Collaboration Content Analysis Results

		Student A	Student B	Student C	Student D
Leadership	Decision making				
	Tutoring				
	Explaining assign				
	Organizing				
	Initiating project				
	Initiating discussion				
	Affirming				
	Evaluating				
	Pushing process				
	Reminding				
	Problem solving				
	Capitalizing				
Support	Offering help				
	Interrogating				
	Responding				
	Suggesting				
	Asking for help				
	Depending on others				
	Brainstorming				
	Asking for confirmation				
	What do you think?				
	Providing info				
	Focusing on details				
Negotiation	Agreeing				
	Disagreeing				
	Chit chatting				
	Encouraging				
	Confusing				
	Arguing				
	Conflict				
	Worrying				
	Thanks				
	Complaining				
	Apologizing				
Cognition	Demonstrating				
	Analyzing				
	Reasoning				
	Explaining				
	Criticizing				

APPENDIX B: Numbers of Discussion Posts from Team One (Four Students)

Styles	Terms	T1P1	T1P2	T1P3	T1P4
Convergent	Problem solving	14	1	3	1
	Decision making	26	2	7	
	Practical application of ideas	18	5	8	4
	Logical / systematical thinking	9	4	6	4
	Analyzing idea	21	8	10	5
Divergent	Adaptive ability	11	2	3	6
	Brainstorming ability	3	8	6	4
	Social / interpersonal	28	34	21	18
	Feeling oriented	4	13	10	9
	Patient, impartial, considered, thoughtful judgment	6	4	2	9
Assimilating	Create theoretical models		1	3	6
	Assimilating disparate observation into an integrated explanation	6	3	3	9
	Being realistic	5	4	3	14
	Concerned with ideas and abstract concepts		2	4	7
Accommodating	Emphasize practical applications as opposed to reflective understanding	3	9	18	5
	Rely heavily on other people for information rather than on their own analytic ability	2	9	21	12
	Impatient and ‘pushy’	10	18	7	11
	Solve problem in an intuitive trial-and-error manner		13	4	8
	Likely discard the plan or theory, quickly adapt oneself to changing environment	2	1	2	2
	Being flexible			1	
	Doing things, carrying out plans	9	10	6	

APPENDIX C: Numbers of Discussion Posts from Team Two (Four Students)

Styles	Terms	T2P1	T2P2	T2P3	T2P4
Convergent	Problem solving	2		2	2
	Decision making	3	3	3	4
	Practical application of ideas	5	6	9	4
	Logical / systematical thinking	2	1	5	2
	Analyzing idea	8	8	8	5
Divergent	Adaptive ability	4	2	1	
	Brainstorming ability	4	1	6	3
	Social / interpersonal	17	12	13	18
	Feeling oriented	6	3	3	1
	Patient, impartial, considered, thoughtful judgment	2	3	2	
Assimilating	Create theoretical models				
	Assimilating disparate observation into an integrated explanation	2	2	4	3
	Being realistic	2	1	3	5
	Concerned with ideas and abstract concepts	3		3	2
Accommodating	Emphasize practical applications as opposed to reflective understanding	5	1	3	3
	Rely heavily on other people for information rather than on their own analytic ability	11		1	
	Impatient and ‘pushy’	4			
	Solve problem in an intuitive trial-and-error manner	2			
	Likely discard the plan or theory, quickly adapt oneself to changing environment	5		6	2
	Being flexible	3	1	9	3
	Doing things, carrying out plans	1	5		3

APPENDIX D: Numbers of Discussion Posts from Team Three (Three Students)

Styles	Terms	T3P1	T3P2	T3P3
Convergent	Problem solving	15	4	12
	Decision making	18	3	12
	Practical application of ideas	24	14	26
	Logical / systematical thinking	14	9	20
	Analyzing idea	23	8	11
Divergent	Adaptive ability	5	8	8
	Brainstorming ability	5	7	12
	Social / interpersonal	37	61	28
	Feeling oriented	10	10	4
	Patient, impartial, considered, thoughtful judgment	2	21	
Assimilating	Create theoretical models		1	
	Assimilating disparate observation into an integrated explanation	4	6	1
	Being realistic	7	5	4
	Concerned with ideas and abstract concepts	1	2	7
Accommodating	Emphasize practical applications as opposed to reflective understanding	2	1	15
	Rely heavily on other people for information rather than on their own analytic ability	10	8	30
	Impatient and ‘pushy’	8	3	25
	Solve problem in an intuitive trial-and-error manner	1		28
	Likely discard the plan or theory, quickly adapt oneself to changing environment	4	2	15
	Being flexible	3	6	4
	Doing things, carrying out plans	8	4	25

APPENDIX E: Numbers of Discussion Posts from Team Four (Three Students)

Styles	Terms	T4P1	T4P2	T4P3
Convergent	Problem solving		1	2
	Decision making			5
	Practical application of ideas	2	5	5
	Logical / systematical thinking	2	3	1
	Analyzing idea	6	3	5
Divergent	Adaptive ability	3		
	Brainstorming ability	4	1	1
	Social / interpersonal	17	8	20
	Feeling oriented	4	2	1
	Patient, impartial, considered, thoughtful judgment	3	1	1
Assimilating	Create theoretical models	1	1	2
	Assimilating disparate observation into an integrated explanation	2	1	2
	Being realistic	2	2	4
	Concerned with ideas and abstract concepts	1	2	1
Accommodating	Emphasize practical applications as opposed to reflective understanding		1	4
	Rely heavily on other people for information rather than on their own analytic ability			3
	Impatient and ‘pushy’			9
	Solve problem in an intuitive trial-and-error manner			2
	Likely discard the plan or theory, quickly adapt oneself to changing environment			4
	Being flexible	1	1	1
	Doing things, carrying out plans	2		5

APPENDIX F: Numbers of Discussion Posts from Team Five (Four Students)

Styles	Terms	T5P1	T5P2	T5P3	T5P4
Convergent	Problem solving	5	2		
	Decision making	3	3	1	
	Practical application of ideas	5	2	2	1
	Logical / systematical thinking	3	1	1	
	Analyzing idea	5	2	5	
Divergent	Adaptive ability	1	1	2	
	Brainstorming ability	2	1	1	
	Social / interpersonal	16	5	4	2
	Feeling oriented	1	2	2	1
	Patient, impartial, considered, thoughtful judgment	3	5	3	1
Assimilating	Create theoretical models	3	2	1	
	Assimilating disparate observation into an integrated explanation	2	2		
	Being realistic	3	3	2	3
	Concerned with ideas and abstract concepts	1			
Accommodating	Emphasize practical applications as opposed to reflective understanding	1	1	1	1
	Rely heavily on other people for information rather than on their own analytic ability	1	3		1
	Impatient and ‘pushy’	1	2	1	
	Solve problem in an intuitive trial-and-error manner	1			
	Likely discard the plan or theory, quickly adapt oneself to changing environment	1			
	Being flexible	1	2		1
	Doing things, carrying out plans	2	1		1

APPENDIX G: CONSENT FORM

Students in Learning Technologies:

I am conducting research on the Learning Technologies course. This study is entitled "How do students with different learning styles collaborate in the online learning environment? "

From this study I hope to learn more about how to design good online courses, and to be able to publish recommendations about how to do that. Your participation is meaningful. There have been very few similar studies carried out before. And the findings from this study are expected to benefit other faculty and graduate students.

This study will be conducted during the Fall semester of 2005, and will span the duration of the course. This research is important: the issues I am studying will improve the online instructional design, and guide the development of similar courses in the College of Education. I am asking for your permission to look over your work, your discussions and collaborations, as well as permission for a if-need-be interview at the end of the course. This subsequent interview will be tape recorded, transcribed, and coded so that I may analyze the results. As part of the study I will also administer a Learning Style Inventory.

Participation is completely voluntary. You may drop out of the study at any time without any explanation. You may retract anything you have said during the interview or you may ask me to stop recording. There is absolutely no connection between your willingness to participate, or the contents of what you say to me, and your grade for this course. There is no known risk from participating in this research. The information we gather during data collection will be kept strictly confidential. Your name will not be associated with any report, publication, or summaries derived from the data.

For any questions regarding the use of human subjects, you may call the Office of Research and Sponsored Programs (Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 1 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224).

For any questions regarding this research, please contact Bo Yang or Dr. Diane McGrath. Contact information follows:

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If you are interested in receiving the results of this study after I have completed the analysis and write-up, I will be happy to share it with you. Please keep my name and email handy so that you can request the results. **Thank you for your Participation!**

I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled.

I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: _____

Participant Signature: _____ Date: _____