THE EFFECT OF LEARNING STYLES ON GROUP DEVELOPMENT IN AN ONLINE LEARNING ENVIRONMENT

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TABLE OF CONTENTS

ABSTRACT

As a student, an educator, and, now, as an instructional designer, I have always been interested in how individuals relate to each other when they attempt to work together. It appeared to me that, more often, the road to a finished product was paved with conflict when individuals had to work together. But what was the cause of this conflict, I often wondered? Online learning's exponential growth and my extended experiences in working with teams in this new learning environment added to my perplexity and encouraged me to systematically study this topic. The purpose of this thesis was to study learning styles as a factor influencing group development in an online learning environment. It specifically examined how an individual group member's learning style influences his/her group development process during online learning as well as how an individual group member's learning style contributes to the development of the group itself during online learning. The results of the literature review pointed to lack of a consensus on matching a learner's learning style with an environment similar to his/her own preference for learning. The analysis of four groups' interactions in an online class for a course of one semester suggested that learning style of the individual does not seem to affect the progression of the group given a sequential stage development model.

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Thank you to Dr. Sue-Jen Chen and Dr. Patricia Comeaux for providing insight and guidance as members of my thesis committee. I am also grateful to the graduate students in this study whose interactions, ups, and downs I followed throughout the semester.

I am also thankful to my peers in the Master of Science in Instructional Technology program. My success in this program is in part due to the classmates I had the privilege to collaborate with. I learned much from them throughout these 3 years.

The support of my family and friends means more than they will ever know. I would not have been able achieve as much as I have in my life without their encouragement and love.

DEDICATION

This thesis is dedicated to my children, John and McKenna. Their love and patience with all my "homework" helped me get through this program. I hope that as they grow they will always be lifelong learners.

LIST OF TABLES

CHAPTER ONE

Introduction

Most students prefer certain methods of learning more than others. These traits, referred to as *learning styles*, form a student's unique learning preference and aid teachers in the planning of small-group and individualized instruction (Kemp, Morrison & Ross, 1998). Grasha (1996) defines learning styles as, "personal qualities that influence a student's ability to acquire information, to interact with peers and the teacher, and otherwise participate in learning experiences" (p. 41). Learning style appears to be distinct from intelligence, ability and personality (Riding & Rayner, 1999).

Few examples of research exist in the area of learning styles and online learning or distance education. Most of the studies focus on the relationships between learning styles and specific student achievement outcomes. For example, in their naturalistic studies, Marton and Saljo (1976) establish a link between learning styles and the outcome of learning. Pask (1988) examined students' distinctive learning strategies and found that students learned more effectively if material was provided in their preferred style. Similarly, Heffler (2001) measured the reliability of Kolb's (1984) learning style inventory (LSI). He notes that in order to optimize outcome, it is better for the student to know his/her own learning style. When instruction is tailored toward their learning styles, students may learn better (Dunn & Dunn, 1978; Pask, 1976).

Validating this connection between learning styles and effective instruction, Verduin and Clark (1991) examined learning styles in the distance education setting. They found that having an understanding of learners' preferences and approaches to learning will help distance educators as well. If educators design instruction to better match learning styles, students may not learn

more easily, but student satisfaction will be higher. As a result, they concluded that awareness of learning styles was indeed an important factor in designing instruction for students learning at a distance.

In summary, research seems to suggest that learners whose learning styles match with teaching or instructional style tend to retain information longer, apply it more effectively, and have more positive attitudes toward the subject of the course than those who were subjected to mismatches in teaching and learning styles (e.g., Dunn, 1995; 1999; Felder, 1993; Rasmussen, 1998; Riding & Grimly, 1999).

Learning styles are classified in many ways and with different instruments to measure them (e.g., Dunn & Dunn Learning Styles, 1978; Gardener's Multiple Intelligence Theory, 1983; Grasha-Reichmann Learning Style Scales, 1996; Kolb's Learning Styles, 1984). Felder and Silverman (1988) have also synthesized findings from a number of studies to formulate a learning style model with several dimensions: What type of information does the student preferentially perceive (sensory/institutive)? Through which modality is sensory information most effectively perceived (visual/verbal)? With which organization of information is the student more comfortable (inductive/deductive)? How does the student prefer to process information (active/reflective)? How does the student progress toward understanding (sequential/global)? Given these five questions, Felder and Silverman (1988) and later Soloman and Felder (1998) developed the Index of Learning Style (ILS).

Across the spectrum, the review of the literature shows that individual differences are significant to learning and instruction (Jonassen & Grabowski, 1993).

Despite the extent of literature on learning styles and the consensus that individuals do develop preferences for learning, currently little information exists concerning how profiles of

generic learning styles correlate with other critical dimensions, such as the group Development of student-to-student interaction.

Theorists have long emphasized the importance of group interaction and its potential effect on individuals (Bonner, 1959; Durkheim, 1964; Homans, 1950; Stogdill, 1959). Research in group interaction has indicated that an individual's behavior is different in groups than when alone (Baron, Moore, & Sanders, 1978; Marukus, 1978; Shaw, 1981). Evidence shows that the effect others have on individual performance can either enhance or interfere with performance (Cottrell, 1972; Zajonc, 1965).

For example, individuals seem to learn faster when working together than working alone (Barton, 1926; Beaty & Shaw, 1965; Perlmutter & deMontmollin, 1952). Moreover, research suggests that groups perform better in problem-solving activities (Husband, 1940; Kanekar & Rosenbaum, 1972; Tuckman & Lorge, 1962; Watson, 1928). However, groups do not always perform as well in activities which involve making judgments (Burtt, 1920; Gordon, 1924; Marston, 1924).

Technologies have extended the learning for individuals and groups well beyond the boundaries of traditional face-to-face interaction. The technologies, such as computer-conferencing, computer-aided instruction, and web-based instruction, are expanding to accommodate anytime, anywhere learning (Horton, 2000). Online learning and distance education, which encompass these technologies, offer an asynchronous learning environment with students and educators communicating through personal computers and phone lines (Davie & Wells, 1991; Eastmond, 1992).

Those who advocate online learning claim that the learning outcomes of traditional face to face instruction can still be achieved virtually (Chadwick, 1999). For example, Jonassen and

Kwon (2001) assert that groups are more on-task in online environments than those in face to face environments.

One of the major attributes of online learning environments is learners' access to different means of communication (e-mail, discussion forums). Learners can interact with each other and with the instructor via computers and Internet at any time and any place. The term computer-mediated communication (CMC) is used in the literature to refer to human communication mediated by computers (Comeaux, 1993). The emphasis on computer-mediated communication within online learning environment has its theoretical underpinnings in constructivist theory, arguing that such an environment provides more opportunities for learners to construct knowledge through active learning and collaboration (Romiszowski & Maso cited in Jonassen, 1996). Researchers who studied CMC, therefore, confirm that it promotes active and cooperative learning (Shedletsky, 1993). Noting the important role of interaction in a learning environment, Moallem (2002) underscores that the support of a group "with a common learning objective can produce a synergistic facilitation of learning" (p. 175).

Moreover, research suggests that the dynamic of online collaboration supports learning as more than just a teacher to student transfer of knowledge (Wildner-Bassett, 2001 as cited in Comeaux, 2002). Gilbert and Moore (1998 as cited in Daugherty, 2003) assert student online interactivity enhances learning. Online learning can be advantageous to the student (Liaw & Huang, 2000, as cited in Daugherty, 2003) because it appears to better facilitate and encourage individual and group communication. In sum, collaborative learning is crucial to the effectiveness of online learning environments (Hiltz, 1997).

An increasing number of researchers have examined the role of group development and interaction in an online environment (Graham, 2002; Yaverbaum & Ocker, 1998). However, not

many research studies examined the impact of individual learning styles on group interactions. As one of the very few studies that examined learning styles' influences on group interaction, Dunn and Dunn (1978) found that many styles are, in fact, responsive in the group environment.

The purpose of this study is to examine the effect of individual learning styles on group development within an online learning environment. The study aims to specifically answer the following questions:

1. How does an individual group member's learning style influence his/her group development process during online learning?
2. How does an individual group member's learning style contribute to the group's development during online learning?

Theoretical Framework

This section will review the definitions, theories, and models upon which the study is based.

Learning Styles

In this study "learning style" is defined as the preferred manner in which an individual or group assimilates, organizes, and uses information to make sense of the world, including a classroom (Felder, 1996). In other words, learning styles are characterized by how we prefer to learn (Silverman and Felder, 1996), specifically our preferences for:

- How we process information (actively vs. reflectively);
- The type of information we receive (sensory vs. intuitive);
- How we perceive information (visual vs. verbal); and
- How we understand information (sequentially vs. globally).

It is also assumed that, given the current literature, these styles of processing and learning could make a difference in students' academic achievement (e.g., Kim & Michael, 1995; Saracho, 1993; Zhang, 2002).

Consistent with the above assumptions and theoretical underpinnings, Soloman's and Felder's (1998) Index of Learning Style (ILS) instrument is used to measure the above listed four dimensions of learning. The Index of Learning Style (1998) consists of a 44-item, self-scoring instrument, which assesses preferences on four dimensions of learning (the fifth dimension, inductive/deductive was removed from the index later) active/reflective, sensing/intuitive, visual/verbal, sequential/global.

Felder's & Silverman's four learning style dimensions are also used to provide the overarching framework upon which the instructional materials for this study were designed and developed.

Group Development

In this study, *group* is defined as "a human communication system composed of three or more individuals, interacting for the achievement of some common purpose(s), who influence and are influenced by one another." (Rothwell, 2004, p. 48). In order to develop a framework that can aid the researcher to examine group development, several theories were reviewed. The synthesis of this review suggests that there are two main categories of theories regarding the development of groups over time: recurring and sequential.

The first, recurring-phase models (e.g. Bales, 1951; Schutz, 1966), suggest that certain issues tend to dominate group interaction during various phases but that these phases do not follow a particular, consistent order. Rather, phases emerge, recede, and emerge again within a group (Forsythe, 1983).

Differing from recurring-stage theories of group development, sequential-stage theories advocate that groups follow linear phases of group development. For example, Hare and Naveh (1984) identify four stages in problem-solving groups: latent pattern maintenance, adaptation, integration, and goal attainment.

Similiarly, Bruce Tuckman's (1965) sequential-stage model suggests the typical order of stages in group development (see Table 1). Tuckman's original four stages of group development are Forming, Storming, Norming, and Performing. The fifth stage of Adjourning was added later based on his review of group development research in the preceding ten years. (Tuckman & Jensen, 1977). The first stage, Forming, is characterized by group members' development of bonds, information exchange, and orientation towards each other, and is considered a calm stage in group development.

Following this initial stage is the second stage of Storming. Behavior during this stage includes group members in conflict with solutions being sought for improvement. The third stage of Norming finds the group regulating its behavior. Performing, the fourth stage, is marked by emphasis on task performance and productivity. The final stage of Adjourning results in the group's termination as tasks have been completed.

Table 1: Tuckman's 5 stages of group development and their characteristics

Stage	Major processes	Characteristics
Forming	Development of attraction bonds; exchange of information; orientation towards others and situation	Tentative interactions; polite discourse; concern over ambiguity; silences
Storming	Dissatisfaction with others; competition among members; disagreement over procedures; conflict	Ideas are criticized; speakers are interrupted; attendance is poor; hostility
Norming	Development of group structure; increased cohesiveness and harmony; establishment of roles and relationships	Agreement on rules; consensus-seeking; increased supportiveness; "we" feeling
Performing	Focus on achievement; high task orientation; emphasis on performance and productivity	Decision making; problem solving; increased cooperation; decreased emotionality
Adjourning	Termination of duties; reduction of dependency; task completion	Regret; increased emotionality; disintegration

Both recurring-phase models and sequential-phase models provide frameworks to observe, track, and better understand group development. Forsythe (1983) notes the disparities between the two categories are small, and that the movement of groups through stages occurs as common themes occur and re-occur, often following a pattern similar to Bruce Tuckman's five stages.

Tuckman's model continues to be one of the mostly widely accepted for describing group development stages and provides the framework for group analysis in this study.

Online Learning

The term *online* is generally referred to that which takes place through the Internet. Online learning, then, refers to instruction occurring in an online environment. Students interact in this context through the use of tools which facilitate both synchronous and asynchronous communication.

While online learning is a complex issue, one aspect is *computer mediated communication* (CMC), referring to interaction or learning facilitated through computers or in online learning environments. For example, online course management systems such as WebCT and Blackboard provide a design framework for course content and communication. Students interact through available tools such as electronic mail, chats, and discussion forums.

Both online learning and computer-mediated communication can be classified under the umbrella term *distance education*. The Association for Educational Communications and Technology defines distance education as "institution-based, formal education where the learning group is separated, and where interactive telecommunications systems are used to connect learners, resources, and instructors" (2003).

Methodology

Participants

Fourteen female students and one male student participated in the study. All students enrolled in a graduate-level, core course for a Master of Science in Instructional Technology program at a university in a southeastern state. The course was offered during the Fall of 2004. It is the first course that students take in the Instructional Technology program, which lays the framework of instructional theories, learning theories, and instructional strategies in instructional design. The course examines multidisciplinary and multicultural influences upon instructional theory and development. The course was offered completely online using WebCT's course management system.

Instructional Materials

The instructional materials were organized in fifteen weekly lessons or modules. Student communication for each weekly lesson or module was facilitated by employing WebCT's Forum Discussion, Mail, and Chat tools. Other instructional materials were presented through WebCT content modules. Instructional materials and strategies for the course were developed to appeal to students' multiple learning styles.

Though the course provides fifteen weekly lessons, instructional materials specifically addressing learning styles were only developed for weeks 2, 4, 6, 8, and 10. Because of the development time involved, five weeks were chosen to represent the beginning, middle, and the end of the course.

Procedures

During the first week of the class, students were asked to complete an online version of the Soloman-Felder Index of Learning Styles (ILS) Questionnaire (see Appendix B – Index of

Learning Styles Questionnaire) and report the results to the instructor in an autobiography called "Know about me". Students were then asked to post their biographical information in the Discussion forum. In the posting, in addition to the results of the learning style survey, students were to include a brief description of themselves, short-term and long-term academic and career goals, learning philosophy, and expectations of the course.

Upon completion of the ILS, the results display the student's score on a scale of 1-11 for each of the four dimensions of measured styles: Active/Reflective, Sensing/Intuitive, Visual/Verbal, and Sequential/Global. A score of 1-3 indicated a balance of the styles, 5-7 indicated a moderate preference for a style, and a score of 9-11 indicated a strong preference for a learning style on the scale.

On the basis of the autobiography and results of the learning styles inventory, students were formed into four collaborative groups. Group 1 was a homogenous group with four females having similar learning styles but different content backgrounds. Group 2 was also a homogenous group with three females having similar content backgrounds and similar learning styles. Group 3, with four females, was a heterogeneous group given learning style, content background, and experience. Group 4 had three females and one male and was a homogenous group with balanced learning styles, but different backgrounds.

Students were responsible for accessing each week's lesson area in WebCT to review content and complete assigned readings. Based on the lesson content, each student completed eight individual assignments during the course in order to become prepared for the team assignment and group discussions. Upon submission of individual assignments, teams worked collaboratively to complete ten weekly group activities posted their results to the Discussion Forum.

Team members communicated through WebCT's Discussion Forum, e-mail, and chat tools, as members preferred, in order to complete activities. Team members' communications were observed to provide insight regarding group development. It should be noted that students' interactions were observed and tracked only during week 2, 4, 6, 8, and 10. These five weeks present the lesson materials specifically designed to address varying learning styles. Observing and tracking of group development during these times provided examples of student interactions at the beginning, middle, and end of the course.

To complete the team activities, team members had a week to complete the activity, the final version of which was posted to the Discussion forum under the appropriate topic. The process each team followed to solve the case or problem, the sharing of resources and ideas among team members, and the collaboration towards reaching an agreed solution were closely monitored.

Each student was asked to keep a learning log during the semester which documented what course materials each student used to study or to prepare for assignments and tasks, what materials each student found most useful and why, and what materials each student wanted to have access to but did not find in the course weekly lesson. These logs were kept in the Discussion Forum area, with each student having a private topic area to use. Each student was also asked to rate individual group member participation in each weekly group activity.

Data Sources

The data was gathered from multiple sources to test the consistency of the findings. The following strategies were used to gather data.

- Results of learning styles inventory
- Students' autobiographical papers

- Students' postings in collaborative team discussion area
- Teams' chat logs
- Teams' final responses (products) for each team activity
- Instructor's comments and feedback on team responses

Analysis Strategy

The data sources listed above were used in the analyses of this study. Each student's biographical sketch (which included a brief description of themselves, short-term and long-term academic and career goals, learning philosophy, expectations of the course, and the results of the Index of Learning Styles Questionnaire) was analyzed to identify student's learning style and to assign each student to one of four collaborative groups.

The student interactions with their team members were analyzed using a coding scheme developed based on Tuckman's stage development model (1965) (see Appendix D – Coding Scheme based on Tuckman's Stages of Group Development). The unit of analysis for the coding scheme was a sentence rather than a phrase or the entire posting.

Before coding student interactions, transcripts of each discussion forum for the four collaborative team discussions were saved. All real names were removed from the transcripts and pseudonyms were assigned to protect the participants' identify (e.g. "John Doe" substituted with "T1-S1" indicating this student is in the first team and is the first student).

Using the printed transcripts and the developed coding scheme, the researcher read each student's posting for the 5 chosen assignments. Each sentence in the posting was labeled to indicate the category and specific characteristic. For example, student T4-S1 posted "Please send me some feedback with improvements that I can make." In the margin next to the sentence, the

researcher labeled this unit “P6”, the code which describes a statement which may “provide or elicit feedback concerning task”.

In addition to assigning each statement a code, memos were noted to record the researcher’s thoughts on the statement tone, student behavior, and overall trends of the student interactions.

After the coding of all postings, a spreadsheet was created to log team number, activity number, student name, posting statement, statement code, and learning style of the student who posted the statement. Researcher comments were logged as well.

Using the data logged in the spreadsheet, formulas were created to reveal trends in the discussions of each individual as well as the development of the group. Using the formulas, the results were analyzed for trends suggesting the sequential pattern of group development. Each group’s trends were then compared to determine if the homogeneity or heterogeneity of the group was a factor in the pattern of development. Bar graphs were then created to visually represent the findings.

Similarly, data were gathered for each individual to determine frequency and percentage of a student’s postings in each of Tuckman’s suggested stages. Data were then analyzed for trends of the individual following or not following a sequential process of group development. Bar graphs were then created to visually represent the findings.

Coding data were then analyzed within the context of learning styles. Student data was compiled and divided by learning style into a separate spreadsheet. Bar graphs were then created to visually represent the findings.

Providing another source of student interactions, transcripts of two of the four team's chat logs for weeks 2, 4, 6, 8, and 10 were also reviewed and analyzed for alignment with Tuckman's stages. The other 2 groups did not use the chat tool.

After the discussion forum and chat log transcripts were coded and analyzed, results of each student's learning styles index were again used to examine their role in each group's alignment or misalignment with Tuckman's model.

Results

Results were gathered in three areas – homogeneity of the groups, individual progression through sequential group development, and the group's pattern of development.

The homogeneity of 3 of the groups and the heterogeneity of the 4th group were examined as factors affecting sequential group development. Results showed, in terms of product quality, the heterogeneous Team 3 had the most content errors, but still produced good work. However, it is clear that team members were very supportive of one another both personally and during completion of tasks. With the highest percentage overall of postings in the Performing stage (69%) it can be assumed that if the team had not lost 3 out of its 4 original members the products may have improved with continued collaboration.

The homogeneous groups were not without some content errors, but overall produced excellent work. Two of the three groups had low Storming percentage totals, with the third group (Team 4) experiencing an extremely high storming rate in comparison due to conflicts between 2 team members.

Based on this analysis, it does not appear that forming groups with similar or different learning styles ultimately affects the overall quality of work in this setting.

The second focus of analysis was the learning styles of each team member as a variable in his/her progression through the linear stages of group development. Based on the findings, only 4 of the 15 students showed trends towards progressing through the Forming, Storming, Norming, Performing, and Adjourning stages of group development.

Interestingly, the 4 students who did show trends towards sequential group development each had different learning styles. It could be expected that students scoring higher on the Sequential dimension of Sequential/Global scale of learning styles would be more likely to progress through linear stages of development consistently through the life of the team. However, that is not indicated in these findings.

Rather, of the 7 students who scored clearly as a Sequential learner, only 1 student showed a pattern of group development. The remaining 11 students showed no tendencies towards following the group development model proposed by Tuckman.

Finally, results were gathered for overall group trends in sequential stage development. Two of the four groups showed tendencies towards following Tuckman's suggested linear progression of Forming, Storming, Norming, Performing, and Adjourning. Though a group's total postings and overall ratios may point to a pattern, when each team activity is examined for trends, it is apparent that there is not enough consistency to declare they have followed a linear pattern.

Any relationship of team member learning style to the group's overall tendency is not apparent. For example, though none of Team 2's members showed individual patterns of following linear stages of development, the group as a whole did show a slight tendency to progress through the suggested stages of group development.

In summary, it does not appear that the formation of groups based on student learning style is a predictor of the individual's or the group's following a sequential pattern towards group development. Similarly, the tendency of the student or the group as a whole to develop sequentially did not appear to be determined by working with other students either with similar or with different learning styles from their own.

Implications of Study

There are implications of these findings to the design of instruction. These findings suggest that the stages of group development measured by Tuckman are not influenced when groups are formed primarily by student learning styles. Many educators and instructional designers employ groups as part of an instructional strategy. With the goal of choosing a strategy to help the learner achieve the instructional objectives, the selection of which individuals should work together was assumed to have a potential impact on meeting these objectives.

If this is to be true, then it is imperative the educator/instructional designer consider the multiple perspectives that form a student's approach in a learning environment, considering other factors such as his/her age, disciplinary background, work experience, and the complexity of the task.

CHAPTER TWO

Literature Review

Research in the area of learning styles is rich. A complexity of terms is used in literature to describe an individual's approach to learning, but among those, "learning style" is generally agreed upon to refer to the preferred manner of learning. An individual's learning style not only influences how he/she receives and assimilates instructional material, but the dynamics of the group that individual belongs to. Research continues to explore these issues with the exponential growth of online learning. The literature review that follows presents an overview of relevant findings in the areas of learning styles, group development, and online learning. The research presented in this chapter serves as the framework upon which this study is based.

Learning Styles Defined

The review of learning styles literature found an assortment of terms that are similar, yet quite distinct. These terms all relate to an individual's approach to learning – they include "learning preferences," "learning strategy," "cognitive strategy," "cognitive style," and "learning styles." In order to understand the concept of learning style in learning and instruction it is important to provide clarification of these terms.

The consensus of research is that students prefer certain methods for learning new material. These preferences referred to as *learning styles*, are unique and aid teachers in the planning of small-group and individualized instruction (Kemp, Morrison & Ross, 1998).

McLoughlin (1999), who reviews definitions of terms relating to learning styles, argues that the main difference between the terms learning style, learning strategy, learning preferences and cognitive style is the degree to which they can be observed and assessed. She defines learning preference as "favoring one method of teaching over another" and learning and

cognitive strategies as “adopting a plan of action in the acquisition of knowledge, skills or attitude” (p. 3). McLoughlin defines cognitive style as “a systematic and habitual mode of organizing and processing information” (p. 3).

McLoughlin further elaborates on the assessment of learning style and cognitive style by suggesting both can be either expressed or observed as students think aloud. However, she notes that these are often assessed using a questionnaire or psychometric test.

Learning style appears to be distinct from intelligence, personality, and not determined by gender (Riding & Rayner, 1999). Grasha (1996) defines learning styles as, "personal qualities that influence a student's ability to acquire information, to interact with peers and the teacher, and otherwise participate in learning experiences" (p. 41).

For the purpose of this study, “learning style” is defined as the preferred manner in which an individual or group assimilates, organizes, and uses information to make sense of the world, including a classroom (Felder, 1996).

Learning Styles and the Outcome of Learning

Learning style as an individual-difference variable in academic achievement has been studied. This research suggests that students’ styles of learning and thinking make a difference in achievement. For example, Marton and Saljo (1976) established a link between how students approach learning and the outcome of learning, introducing the term “approach to learning”. Their study sought to explore qualitative differences in what is learned and to describe the functional differences in the process of learning resulting in qualitative differences in outcome. In their naturalistic study, each student was asked to read one or more passages of text and was then asked questions about the content of the text. Students’ answers were noted in terms of the

pattern of response, attempts at recalling information, and the answering of comprehension questions.

During this study, Marton and Saljo found two approaches to learning: deep-level and surface-level. The deep approach describes active engagement with the content, resulting in extensive elaboration of the learning material while seeking personal understanding. In contrast, the surface approach indicates the use of routine memorization to reproduce those aspects of the subject matter expected to be assessed. Marton and Saljo concluded there is a diversity of ways in which the same phenomenon, concept or principle is learned by different students.

Entwistle (1979) also investigated approaches to learning. Like the participants in Marton and Saljo's study, students in Entwistle' study were asked to read an article and answer questions which related both to what they had learned and how they had learned it. Students' responses were coded to indicate outcome (in terms of level of understanding, integration, and knowledge of main points) and approach to learning (based on the characteristics of deep and surface approaches). Entwistle concluded that the two factors covering a deep approach found in the study could offer tentative evidence that this type of difference in learning does occur and suggested possible descriptions of the links between approach, process, and outcome.

Likewise, Pask (1972), in his review of several studies, concluded students are forced to make explicit their approach to learning, because of the understanding requirement. Students adopted one kind of strategy to the exclusion of others.

Matching Learning Styles with Teaching Styles

Though most research acknowledges the relationship between learning styles and learning outcomes, there remains a question as to the benefit of matching a student's preferences for learning with a teacher's style for presenting material to be learned.

Pask and Scott (1972) examined the condition of matching or mis-matching a student with his/her preferred learning strategy. Pask believed that it was necessary to provide unfamiliar material to be learned in order to study intellectual learning. Therefore, Pask and Scott created two new animal taxonomies called Clobbits and Gandemullers. The 62 participants were students from two polytechnics courses divided into two groups of 32 students each. The participants were required to establish the principles of classification for these two new taxonomies of species. Students were instructed using a either a Free learning condition or Teachback condition. Free learning conditions offer no imposed teaching strategy. A Teachback condition requires the learner to "teachback" the topic by providing both non-verbal demonstrations and verbal explanations of "how" and "why".

Pask and Scott concluded that those students with matched learning style and teaching style consistently performed better than mis-matched, only needing 1 to 3 iterative repetitions (serialists) to mismatched needing 4 to 7 (holists). This result suggested that matching styles improves learning.

Elaborating on this study, Pask (1976) noted that students are normally presented subject matter in only one particular way, yet they consistently prefer a particular type of learning strategy, when given a choice. If the teaching strategy is matched to the same type of learning style the student will learn more quickly and retain the information for longer. Conversely a mismatched condition leads to grossly inferior performance and a pronounced failure to comprehend the principles underlying the subject matter.

More recently individualized instruction based on learning styles was cited as contributing to an increased passing rate of the ACT College Entrance Exam's Writing skills component. Rochford (2003) studied a community college using a learning styles approach to

increase the passing rate of ESL students taking the ACT Writing skills test. Participants included 53 ESL students in the control group and an experimental group of 56 students. Both groups were prepared using learning styles responsive materials and taught by same instructor. The experimental group demonstrated a significant difference and significantly higher ACT Writing Skills Test scores. Preliminary research suggests that instructors need to understand concept of learning styles and its potential impact on student performance.

Analogous to Rochford's finding, Denig (2004) reviewed research to conclude that matching students' learning style preferences with educational compatible methods was, in fact, beneficial to their academic achievement. Denig cites research conducted by Dunn, Griggs, Olson, Gorman, and Beasley (1995) who conducted a meta-analysis of 42 studies across the United States at 13 different universities during the 1980s. Analysis revealed that students' learning style preferences were enabled them to master new and difficult information, regardless of the researcher, the location, the grade level, or the element(s) examined. The overall, unweighted, group effect size value (r) was .384 and the weighted effect size value was .353 with a mean difference (d) of .755. Referring to the standard normal curve, this suggested that students whose learning styles were accommodated would be expected to achieve 75% of a standard deviation higher than students who had not had their learning styles accommodated.

The studies mentioned above concluded that it is beneficial to present material to a student which is complimentary to his/her preferred learning style resulting in improved performance, will improve, students will learn more quickly and retain the information longer.

However, further review of literature lacks a consensus in the benefits of accommodating student learning strategies. Rather than always providing an unperturbed learning environment, some researchers suggest offering a diverse context which challenges the learner.

For example, in his 1996 article *Matters of Style***,** Felder disagreed that a student's learning style be matched with teaching style. Rather, if educators present learning material only in their students' preferred styles, the students may not develop the mental dexterity and skills needed to reach their potential for achievement in school and as professionals.

Felder found that teaching to the full spectrum of learning styles improves students' learning, satisfaction with their instruction, and self-confidence.

Additionally, Mark Tennant (1997) reviewed research concerning psychology and adult learning. He cites research by Wapner (1978) which questions the benefit of matching teacher and student styles which meet students' expectations and share similarity of viewpoint. Wapner suggests contradiction and obstacles are necessary conditions for individual development and creativity.

The preponderance of research conducted in this area was within the traditional face-to-face instructional context. However, Verduin and Clark (1991) examined this issue as it concerns the online environment suggesting learning styles should be considered in the distance education setting. In their discussion they acknowledged that learning styles impact teaching styles when considering how students acquire new information. They further suggested that though these learning styles may complicate the distance educator's job, they must be considered during the design of instruction. Verduin and Clark stressed that a learner-centered approach to distance education instruction requires a variety of individualized methods, materials, and design.

In summary, there was no consensual agreement in the reviewed learning styles research regarding matching or mis-matching learning styles with compatible teaching styles.

Identifying & Measuring Learning Styles

As mentioned above, learning styles, whether or not they are matched to instruction, are a factor in student learning. In order for an instructor or instructional designer to consider learning styles when designing instruction, these traits must be identified. The literature on how learning styles are defined and measured is extensive. The literature review that follows illustrates the many ways learning styles are classified and the variety of instruments developed to measure them (e.g. Dunn & Dunn, Kolb, and Felder).

Dunn & Dunn (1978) examined research, proposing a learning styles model based on a consensus that students learn in different ways, possibly falling within at least 18 categories classified in 4 main categories:

- *environment* (sound, light, temperature, design)
- *emotional* (motivation, persistence, responsibility, structure)
- *sociological* (peers, self, pair, team, adult, varied)
- *physical* (perceptual, intake, time, mobility).

In 1968, based on their classifications, Dunn & Dunn began developing the first series of questions to elicit learning style preferences which resulted in the Learning Style Inventory (LSI). The LSI is a 100-item inventory in which students mark each statement as "true" or "false". Answers to these statements reveal each student's preferences in 18 categories.

Based on research and clinical observation, Kolb (1984) also suggests categories of learning styles: *convergent, divergent, assimilation, accommodative*. Kolb acknowledges and examines that the foundation of a learner's preferences is found on many levels: Jungian personality types, early educational experiences, career, current job, and adaptive competencies.

To identify where a student's preference fall within these four styles, Kolb developed his own Learning Styles Inventory (LSI) consisting of a nine-item self description questionnaire. The learner is asked to put in rank-order four words in each question in a way which best describes his/her learning styles. Norms for the LSI were developed from a sample of 1,933 men and women age 18 to 60 from a variety of occupations. The LSI measures an individual's emphasis on each of the four modes of the learning process: concrete experience, reflective observation, abstract conceptualization, and active experimentation as well as examining the individual's emphasis on abstractness over concreteness.

More recently, Grash and Reichmann (1996) developed the Grasha-Reichmann Student Learning Style Scales (GRSLSS) inventory designed to identify and categorize learning preferences. Their research identified five teaching styles: expert, formal authority, personal model, facilitator, and delegator and six learning styles: *independent, avoidant, collaborative, dependent, competitive, participant*. Grasha clustered these teaching and learning styles to demonstrate the blends of learning styles that are associated with and compatible with each of the teaching styles.

The GRSLSS 60-item questionnaire serves as a tool to select instructional strategies that are not based on past habits or assumptions, but rather intellectual concerns, to specify the methods to achieve goals as teachers, and to manage issues of student academic performance.

Felder and Silverman (1988) sought to examine the mismatches between common learning styles of engineering students and traditional teaching styles of engineering professors. Learning styles of most engineering students and teaching styles of most engineering professors are incompatible in several dimensions. Felder's and Silverman's study explored:

- Which aspects of learning style are particularly significant in engineering education?

- Which learning styles are preferred by most students and which are favored by the teaching styles of most professors? and
- What can be done to reach students whose learning styles are not addressed by standard methods of engineering education?

Their model proposed that a student's learning style may be defined in large part by the answers to five questions:

1. What type of information does the student preferentially perceive: *sensory* (external) - sights, sounds, physical sensations, or *intuitive* (internal) - possibilities, insights, hunches?
2. Through which sensory channel is external information most effectively perceived: visual—pictures, diagrams, graphs, demonstrations, or *auditory*— words and sounds?
3. With which organization of information is the student most comfortable: *inductive*—facts and observations provided, underlying principles are inferred, or *deductive*—principles are given, consequences and applications are deduced?
4. How does the student prefer to process information: *actively*— through engagement in physical activity or discussion, or *reflectively*— through introspection?
5. How does the student progress toward understanding: *sequentially*—in continual steps, or *glob*ally—in large jumps, holistically?

The Index of Learning Styles (1998), developed by Felder and Soloman, is theoretically based on four learning styles adapted from the model by Felder and Linda K. Silverman. The 44-item self-scoring inventory provides an indication of probable learning tendencies but it is not intended to determine suitability of student for particular subject or profession.

Learning Styles as a variable in online learning

Because of the research in the area of learning styles and the development of instruments to identify them, more attention has been given to this factor as an influence in a student's learning online.

More recently, studies have involved the effect of learning styles within the context of online learning. Sabry and Baldwin (2003) examined using a learner-oriented approach to design a more effective interactive learning system. This study questioned whether designing a diverse set of activities to appeal to varying learning preferences will make an interactive learning system more effective and efficient for learners to learn. Sabry and Baldwin used results of Felder's and Soloman's Index of Learning Styles questionnaire to support a newly formulated balanced learning design model called "BLADE" (Balanced Learning and Design Model). This model seeks to accommodate exhibited learning styles and required skills for class.

In their study, learning style dimensions were measured using the Index of Learning Styles questionnaire in 2 undergraduate levels (L1 first years & L2 second years) with 148 completed questionnaires. Learners in both groups showed high preference for Visual (79% or over), 62% of L1 have stronger preference for Visual compared to 44% of L2's preference for Visual. Both groups had high preference for Sequential (68%), with few learners from either level showing strong tendency towards Intuitive. This study concluded that learning style instruments do not prevent learner's problems in using interactive learning systems, but instead help highlight and predict areas of significance to allow for and anticipate through course design.

Also investigating student learning style as a variable in online instruction, Hallock, Satava, and LeSage (2003) concluded students with auditory learning styles had higher overall grade point averages than those with other learning styles. They further showed that students

whose primary learning style is auditory, or they have adapted to the teaching environment and have evolved into auditory learners, achieved more success in their on-campus courses. This study suggested that students with varying learning styles can perform equally well in on-line courses with regard to final grade earned. Although one or more learning styles may be suited for on-line courses, they argued, others may actually hinder learning in this evolving learning environment. Monitoring student-learning styles over time can also reveal of students are adapting to the new learning environments.

Also examining if learning styles have an influence in online instruction, Lu, Yu, and Lui (2003) identified the impact of student learning styles, learning patterns, and other factors on their learning performance. Six specific research questions were developed and 76 graduate students enrolled in a WebCT course participated in this study. It found that none of the factors, except ethnic groups, showed any significant impact on students' learning performance. The results suggest that, at the graduate level, students are able to learn equally well in WebCT online courses despite their different learning styles.

In summary, learning styles are preferences that a learner develops to acquire and learn new information. It is generally accepted that learning styles, either negatively or positively, do affect learning outcome. The question remains to what extent should instruction be individualized to accommodate these preferences?

Although learning style is studied and measured as an individual-specific trait, it is important to consider the influence of these approaches to learning in a group setting. The following section summarizes research in the performance of groups, factors effecting group performance, and the assessment of group development.

Group Defined

Because of the numerous characteristics and purposes groups, many definitions of the term "group" have been put forth. Lewin (1948) focuses on the relationship of the individuals that form the group by defining the term as "a dynamic whole based on interdependence rather than on similarity" (p. 184). In keeping with this approach, Cartwright and Zander (1968) defined a group as a "collection of individuals who have relations to one another that make them interdependent to some significant degree." (p. 46).

This thesis examines the relationship of the individual and the group in terms of their interactions and their progression towards completion of tasks. Therefore, for the purposes of this study, the following definition has been adopted: "a human communication system composed of three or more individuals, interacting for the achievement of some common purpose(s), who influence and are influenced by one another." (Rothwell, 2004, p. 48).

The Effect of Groups on the Individual

Recognizing the importance of group interaction and its potential effect on individuals, theorists have long studied the impact of the group on the individual.

For example, Bonner (1959) noted that individuals behave differently in groups than alone. Individuals are affected in groups by psychological influences due to a need for both dependence on and independence from the group which causes conflict for the individual.

Also examining the influence of the group on the individual, Homans (1950) stated that individuals must become part of a group to escape isolation. Within a group, the individual is sustained and balanced.

Evidence shows that the effect others have on individual performance (termed "social facilitation") can either enhance or interfere with performance (Cottrell, 1972; Zajonc, 1965).

The mere presence of others, however, could be enough to influence an individual. Marukus (1978) examined this aspect of social facilitation in his study of the presence of others and an individual's ability to perform a task. In this study, individuals were timed when dressing and undressing in familiar and unfamiliar clothing. Marukus concluded that just the presence (there was no interference of any kind) of others is sufficient to cause interference by effecting the performance of the individual . Zajonc (1965), after reviewing social facilitation studies, concurred with this finding as well.

In contrast to theories of the influential mere presence of others, Baron, Moore, and Sanders (1978) proposed that this presence is a distraction to the task affecting simple and more complex tasks differently. They assert that in attempting to perform a simple task, the interferences are inconsequential and present a conflict that can still be overcome, allowing the individual to perform. However, interference during more complex tasks serves to impair

individual performance. In support of their assertion, the researchers asked individuals to perform a simple task of learning a non-competitional word list in the presence of a group. The participants learned more efficiently when in a group than when alone. However, a more complex task of learning a competitional word list was not performed as efficiently in the presence of a group.

In addition to the research of group influence on the individual performing tasks, the individual's ability to learn in a group has been studied. For example, Perlmutter and deMontmollin (1952) asked 20 three-person groups to learn two lists of two-syllable nonsense words. The first list of words was learned through group interaction. The second list of words was learned individually. The study analyzed the rate of recall of the nonsense words learned as a group vs. the rate of recall of the nonsense words learned individually. Perlmutter and deMontmollin found that those working in a group had a significantly higher rate of recall, thereby supporting the superiority of learning in a group context.

These studies suggest that an individual's actions can be influenced by the existence of others to some extent, either positively or negatively, as well as affecting the individual's performance. Examining this group effect further, additional research has studied the group vs. individual performance during problem solving. The following section presents research in the area of problem-solving in groups.

Problem-Solving in Groups

Research has studied whether individuals solve problems better when working together than working alone. Barton (1926) conducted an experiment to examine individual's and groups' approach to problem solving. The participants consisted of two groups of 11 ninth grade students each, all of whom were new to Algebra. After Barton instructed both groups on the techniques of problem-solving in algebra, a four day period was spent by both groups in actually solving problems. Group A solved the problems using the discussion method which elicited participation from each group member as they discussed the steps involved in solving the problems. After the group discussion of steps, individuals completed the assignment. Members of Group B, however, solved the problems individually, with no group collaboration allowed. Based on the examination of both groups' results, Group A (the discussion group) had test scores ranging from 3 to 7, while scores of Group B (the individual-assignment group) ranged from 2 to 6. Barton tentatively concluded that the group-discussion method resulted in superior problem solving ability.

Further examining a group approach to problem-solving, Watson (1928) studied the intellectual efficiency of a group compared to the efficiency of the same individuals working alone. In his study, the 108 graduate students were given four words. The students first worked individually to construct as many new words from the letters these words contained. After working alone, the same students were divided into twenty groups ranging from three members to ten members each. Once in their groups, the members collaborated to construct a group list which included the words each individually had already listed. Working individually, the average student constructed 32 words. Through cooperative work, those same students worked in a group to construct an average of 75 words. Watson observed that every group produced more words

than the best individual of the group working alone. Based on this, Watson suggested that the group approach to solving the problem is superior to that created by an individual.

Testing the assertion that the group approach leads to superior problem solving, Tuckman and Lorge (1962) tested the hypothesis that a group is not necessarily more effective in problem solving as a whole, but rather that there is an individual within the group responsible for bringing the group towards the solution. They examined the solutions to a problem from 70 randomly selected groups of 5 men each compared to 70 men working on the problem individually. Their observations noted an ineffectiveness of the group process in the formed groups, evidenced by the forming of sub-groups, individuals within the group working independently, and some members of the groups not participating. The data confirmed that having at least one member of the group with a higher ability could lead to the group's ability to solve the presented problem, and not the group's ability to function as a cohesive, communicative unit.

Group Characteristics

As cited earlier in this chapter, a group contains three or more individuals, interacting to achieve a common goal. The number of individuals is one aspect of groups that has been studied to better characterize groups. Research suggests many students respond best in groups of two to five peers, as opposed to being in groups containing authority figures (e.g. teachers) (Dunn & Dunn, 1978). This could possibly be due to feeling intimidated, anxious, the need for interaction of friends to stimulate them to learn, feel more comfortable in group and when task is shared. Learning styles are best served if permitted to work in groups.

Further examining the effect of working in peer groups, Moallem (2002) cites research suggesting that small groups of three to four students are preferable for many reasons: (1) reduces the likelihood that members take a free ride on the contributions of others (Shepperd,

1993); (2) makes it easier for the instructor to monitor individual contributions and to scaffold each team's progress; (3) provides more opportunities for quality interaction and improves commitment to the group; (4) improves each student's social skills to interact smoothly with others at the group level; (5) helps team members by developing needed behaviors and eliminating deferring behaviors to facilitate the productivity of the group; and finally, (6) helps teams see the value of working together.

Gordon (1924) also argued that "group" judgments are superior to those made by the individual. In his study of judgment of weights, group judgments yielded much higher correlations, reaching .94 vs. the .41 correlation of individual judgments.

As a result of his research, Will (1997) offered guidelines for effective group learning. He proposed that, ideally, groups should be heterogeneous with respect to age, gender, race, background, and interests. Heterogeneous groups, he suggested, offer a diversity of concerns and perspectives. However, Will conceded, it may be preferable to create homogeneous groups in certain situations. For example, in an organizational long-range planning session, the facilitator may choose to group people by department or division so that each unit can identify its needs and concerns.

In summary, theorists have long studied groups in terms of how others affect an individual's ability to learn, perform tasks, and solve problems. Studies have compared individuals to groups in terms of learning outcomes, making judgments, and problem solving, finding that group-processes towards these goals are often superior. Recognizing the significance of these functional units, research began to focus on how these individuals progress towards becoming a group.

Assessing Group Formation

In order to develop a framework that can aid the researcher to examine groups and group development, several theories were reviewed. The synthesis of this review suggests that there are two main categories of theories regarding the development of groups over time: recurring and sequential.

Shutz's (1966) recurring-phase model, Fundamental Interpersonal Relationships Orientation (FIRO), claims that groups develop in a parallel manner in response to individual needs. In an attempt to explain interpersonal behavior in terms of how people orient toward others, the first phase, *inclusion*, involves defining boundaries, i.e. who's 'in' and who's 'out'; the second phase, *control,* involves resolving conflicts of structure and leadership, i.e. who's 'top' and who's 'bottom'; the third phase, *affection*, concerns inter-member harmony and group cohesiveness, i.e. who's 'near' and who's 'far'. Typical of recurring stage models, these processes are cyclical but near the termination of the group there is a reversal of the phases with less cohesiveness and, finally, *diffusion* of boundaries.

Another example of a recurring-phase model of group development is Bales' (1951) Interaction Process Analysis. Bales proposed a structured system of observation of groups consisting of a structured coding system. Bales' Interaction Process Analysis (IPA) classified each bit of behavior performed by a group member into one of twelve categories. Bales' categories reflected both socio-emotional activity as well as task activity.

IPA is a term adopted to designate a body of methods developed over 20 years. He studied groups formed for group discussion and group therapy, for counseling, planning, training programs, and experimental teaching procedures as well as policy forming committees, boards and panels, diagnostic councils in clinical work, problem-solving groups in experimental social

psychology and sociology, teams and work groups, family and household groups, children's play groups, adolescent gangs, adult cliques, social and recreational clubs, and small associations.

Differing from recurring-stage theories of group development, sequential-stage theories advocate that groups follow linear phases of group development. Hare and Naveh (1984) identified four stages in problem-solving groups: latent pattern maintenance, adaptation, integration, and goal attainment. Hare and Naveh documented events and analyzed participants during 1978 summit conference between heads of state from Egypt and Israel as they negotiated a framework for peace in the Middle East. The hypothesis that the group development would follow the same series of phases observed in other groups as they deal with four functional problems of groups: providing values, resources, norms, and leadership. Results concluded that the participants in this summit did follow the stages of group development as they had theorized.

Tuckman (1965) reviewed 50 articles dealing with stages of group development separated by group setting (therapy-group studies, T-group studies, and natural and laboratory-group studies). Stages identified in the articles are separated into those descriptive of social or interpersonal group activities and those descriptive of group tasks activities. The way members acted and related to one another are considered to be in the interpersonal realm. The interaction content related to the task falls under the task-activity realm. It is these two realms together that generate the group functioning.

Based on the review, four general stages of development were proposed. A team begins in Forming stage; as team members become aware of differences, they enter Storming stage, characterized by conflict among team members. The team exits the Storming stage by resolving conflicts in Norming stage where norms are established to address team differences. Norming is distinct activity that occurs as a response to conflict (or Storming). General group development concepts identified; Looking at behavior of small groups in a variety of environments, recognized

distinct phases and suggested they need to experience all four stages before achieving maximum effectiveness;

Tuckman (1977) added a 5th stage after refining and developing model with Mary Ann Jensen. This follow-up to the 1965 study seeks to examine whether any empirical tests of the proposed group development had been conducted. Only one study could be found that specifically tested Tuckman's hypothesis. After reviewing 57 studies of group development, Tuckman and Jensen concurred with the proposed importance of the separation of a group, termed "life cycle" model developed by Mills (1964) and amended the earlier model to include the 5th stage of "adjourning".

Most research regarding group development has been conducted prior to the inception of the World Wide Web and its hosting of online learning, there is little information on norm development in a computer-mediated communication (CMC) environment. More recently, Graham (2003) sought to answer how norms develop in a computer-mediated communication (CMC) environment. His study describes how group norms evolve from a general to an operationalized state and seeks to establish a preliminary model of norm development that describes how norms emerge and evolve in small groups. Graham's study investigated Norming in 10 project teams in a first course in a distance master's degree program in instructional systems technology at Indiana University. Using Tuckman's (1965) model as the theoretical framework for group development, Graham found that norms evolve from a general state with fuzzy boundaries to a more operationalized state with clearly defined boundaries.

Factors in Groups

Daugherty and Turner (2003) review research for an article on assessing group dynamics in web-based courses. They cite research that group dynamics patterns may influence student interactivity, and that group composition was an important element in collaborative

environments. For example, Yaverbaum and Ocker (1998) found that outcomes are influenced by individual's comfort level with members of group.

However, learning styles as a factor in groups has been examined in few studies. In a review of related research, MacClintic and Nelson (1996) cite the implications of learning styles for classroom education. The researchers agree that it is not necessarily productive to work in a group containing individuals with the same style, but instead seek out partners with different styles.

Also examining the individual within the group, Shimoda and Takayesu (1997) report the effect of individual learning styles in small group processes. The study observed video-taped sessions of 12 students in a first-year medical school course in neurobiology that used a small group, problem-based teaching method. Students with an identified learning style of "active learner" tended to rate the course higher. Active learners preferred to build concepts interactively, use intuition more than existing concrete models, and tended to continually re-evaluate their understanding of concepts. On the contrary, students who rated the course lower tended to describe themselves as "passive learners" who preferred to model concepts in their heads, used existing concrete models to guide their thinking, and were frustrated by discussions of concepts they feel they already understood.

In summary, given the results of a limited number of studies of learning styles and groups, there does not appear to be a consensus of the degree of influence an individual's approach to learning has in the group.

Online Learning Defined

Because the context in which this study is conducted occurs online, it is important to present reviewed literature concerning online learning.

The term *online* is generally referred to that which takes place through the Internet. Online learning, then, refers to instruction occurring in an online environment. Students interact in this context through the use of tools which facilitate both synchronous and asynchronous communication.

While online learning is a complex issue, one aspect is *computer mediated communication* (CMC), referring to interaction or learning facilitated through computers or in online learning environments. For example, online course management systems such as WebCT and Blackboard provide a design framework for course content and communication. Students interact through available tools such as electronic mail, chats, and discussion forums.

Both online learning and computer-mediated communication can be classified under the umbrella term *distance education*. The Association for Educational Communications and Technology defines distance education as "institution-based, formal education where the learning group is separated, and where interactive telecommunications systems are used to connect learners, resources, and instructors" (2003).

Learning Online

Group vs. individual learning facilitated by computer is examined by Lou, Abrami, and d'Apollonia (2001). This study synthesized the research on the effects of social context (i.e., small group versus individual learning) when students learn using computer technology. In total, 486 independent findings were extracted from 122 studies involving 11,317 learners. The results indicate that, on average, small group learning had significantly more positive effects than individual learning on student individual achievement (mean ES =+0.15), group task performance (mean ES=+0.31), and several process and affective outcomes.

Jonassen and Kwon (2001) noted an absence of research related to problem-solving communication patterns in an online environment. In their study, eighteen undergraduate engineering students taking a required class for their major were randomly assigned to 6 groups consisting of 3 members each. Three of the groups communicated via computer-conferencing methods, with the other three groups communicating using face-to-face methods. Using a coding scheme, communication within each group was analyzed in order to classify interactions in terms of problem-solving function and delineation of problem-solving activity patterns. This study suggested that problem solving online was more efficient, with students in the computer-conferencing groups using more task-directed and focused communications to solve problems, as well as better reflecting the problem-solving nature of the task.

Group Collaboration Online

Collaboration plays a vital role in how students learn. Comeaux and Nixon (2000), in their case study review, noted that in an online environment collaboration can be fostered by structuring learning to allow for communication of individual ideas, promotion of group dialogue and decision making, facilitation of activities, and tracking choices.

Research examining learning outcomes and learner satisfaction indicates that groups can be as effective in online learning environments as those in face-to-face environments.

Daugherty and Turner (2003) note that the tools available in web-based environments (e.g. e-mail, discussions, chats) offer much potential for interaction both socially and interpersonally. They cite research by Gilbert and Moore (1998) which asserts student interactivity enhances learning, with students further benefiting from peer feedback.

Stacy (2002) examined the role of online group collaboration as a contributor to learning in her study of students within MBA program. She found that interactive group discussion was a

factor in the construction of new conceptual understandings. The group interaction allowed for a social context, within which a consensus of knowledge was built based on communicating different perspectives, receiving feedback and discussing ideas. With a content analysis revealing more than 50% of online messages as social in nature, Stacy concluded that the social context of group collaboration maintained cohesion of the group. This social aspect supported and encouraged individual members and acted as a motivator for students who are studying at a distance.

Online Group Dynamics

The factors contributing to these positive outcomes and satisfaction are explored by Lurey's and Raisinghani's (2001) study of best practices in virtual teams. Their study sought to determine factors which both contribute to and inhibit the success of a virtual team. Based on a survey distributed to 67 individuals forming 12 teams, results indicate that several factors are positively correlated to the effectiveness of the teams. Positive factors contributing to team effectiveness are the teams' processes and team members' relations. Factors of selection procedures and executive leadership styles also moderately contributed to the teams' level of effectiveness. However, the design process, other internal group dynamics, and additional external support mechanisms, did not contribute significantly to greater levels of effectiveness. Lurey and Raisinghani point out that although "virtual," these individuals still form a team, and thus must rely on each other to perform their work.

In summary, online learning environments offer learning opportunities comparable to those in face-to-face environments, with online collaboration promoting active and cooperative learning. Small group learning had significantly more positive effects than individual learning, just as research has shown regarding face-to-face collaboration. Groups using computer-

mediated methods of communication are more task-directed and have focused communications to solve problems.

Summary

This chapter reviewed the research upon which this study was based. The researcher examined and presented many studies which focused on the models and measurements of learning styles and groups as well as online learning. Based on this literature review, it was found that learning styles are preferences that a learner develops to approach the acquisition and learning of new information. Although studies showed learning styles can affect learning outcome either positively or negatively, there was not a consensus as to the extent to which teaching strategies and the learning environment itself should be tailored to these preferences. Measurement instruments have been developed through surveys and questionnaires which allow students and instructors to identify these preferences.

Keeping in mind that these are individual-specific traits, it is important to consider these styles when examining individuals within a group setting. Reviewed group dynamics literature suggested that an individual's actions can be influenced by others. This influence extends to the individual's successful learning outcome and to solving problems. It was found that an individual's performance can be both hindered and encouraged by the group depending on the task itself. Moreover, it was concluded in these studies that the approach to problem solving is superior in groups rather than individually.

Similar to assessing individual learning styles, a group's formation can be evaluated as well. In order to develop a framework in which the researcher can examine group development, several models were reviewed which suggested a group follows a pattern of development. Although most of the studies on learning styles and group dynamics were conducted prior to the growth of online learning, research indicated that an online environment does offer learning opportunities comparable to face-to-face environments. Online collaboration promotes active

and cooperative learning, with research suggesting groups are more task-directed and have more focused communication when solving problems in this context.

CHAPTER THREE

Methodology

This chapter summarizes the methods used to study the effect of learning styles on an individual's and a group's progression of sequential stage development. The following sections outline the design of the study, providing information about the participants, the research procedures, and methods of analysis.

Participants

Fourteen female students and one male student participated in the study. All students were enrolled in a graduate-level, core course for a Master of Science in Instructional Technology program at a university in a southeastern state. The course was offered during the Fall of 2004. It is the first course that students take in the Instructional Technology program, which lays the framework of instructional theories, learning theories, and instructional strategies in instructional design.

Students' ages ranged from 23 to 51 years old. Occupations of the students included educators, nurse educators, and higher education staff (See Appendix A – Student Profiles.

Instructional Materials

The course examines multidisciplinary and multicultural influences upon instructional theory and development. The course was offered completely online using WebCT's course management system. The instructional materials for the online course in which the study was conducted were organized in fifteen weekly lessons or modules. Five weekly lessons (weeks 2, 4, 6, 8, and 10) were selected for this study. The five weeks were chosen to represent the beginning, middle, and the end of the course. Relevant to the content of the course, each weekly lesson or module consisted of the following instructional materials:

- A lesson overview
- Performance objectives
- Required readings
- Individual assignment information
- Team activity information
- Forum discussion topic
- Weekly milestone for the course project (self-instructional materials)
- Instructor's summary notes and lectures
- Self-assessment quizzes on the content of each week's lesson

Student communication for each weekly lesson or module was facilitated by employing WebCT's Forum Discussion, Mail, and Chat tools. Other instructional materials were presented through WebCT content modules.

Instructional materials and strategies for the course were developed to appeal to students' multiple learning styles. For instance, in order to address the type of information students prefer to perceive (sensing vs. intuitive learners), concrete and real world examples were given, examples were provided to demonstrate procedures for activities, creativity in individual assignments and group activities was encouraged, and additional resources and materials were available for each weekly module.

To allow for how students perceive information (visual vs. verbal) materials for each module included notes with charts, images and other graphic organizers. Instructional material for each module was provided in written form and through recorded lectures with detailed explanations and examples.

To address how students process information (actively vs. reflectively), group activities focused on problem solving tasks in a team environment allowing for active learners to engage in critical analysis while working with others. In addition, guidelines were provided for effective team work and team self assessment

To support how students understand information (sequentially vs. globally), step-by-step procedures, including text and visuals, were provided to complete individual assignments and group activities. Also provided was an overview of the material and related assignments for each module, advanced organizers to demonstrate overall structure of course content and individual modules, and the conceptual order of lessons, assignments, and activities.

Procedures

During the first week, students oriented themselves with the course environment, the course requirements, and with their fellow students. Students were asked to post biographical information in the Discussion forum labeled "Know About Me". In the message, students were to include a brief description of themselves, short-term and long-term academic and career goals, learning philosophy, and expectations of the course.

Students were also asked to include information about his/her learning style. To find out this information, students were provided a link to a website in order to complete the Soloman-Felder Index of Learning Styles (ILS) Questionnaire (see Appendix B – Index of Learning Styles Questionnaire). After answering this web-based, self- scoring survey, each student was provided immediate feedback on his/her learning style preferences. The ILS results displayed each student's score on a scale of 1 to11 for each of the four measured styles: Active/Reflective, Sensing/Intuitive, Visual/Verbal, and Sequential/Global.

If a student scored 1-3 on the scale, he/she was fairly well balanced on the two dimensions (e.g. a score of 2 on the Active/Reflective style shows a student well-balanced between Active and Reflective styles). If a student scored 5-7 on the scale, he/she had a moderate preference for one dimension of the scale (e.g. a score of 7 on the Active side of the Active/Reflective style scale shows a student with a moderate preference for Active learning). Finally, if a student scored 9-11 on the scale, he/she had a strong preference for one dimension of the scale (e.g. a score of 11 on the Reflective side of the Active/Reflective style scale shows a student with a very strong preference for Reflective learning).

During the course, students were assessed for the course through completion of eight individual assignments, ten team activities, weekly lesson-related quizzes, and the development of a self-instructional module. In order to complete the team activities, four groups were formed.

On the basis of the autobiography and results of the learning styles inventory, students were formed into collaborative groups. This decision was based on the research that suggests students respond best with groups consisting of between two and five peers (Dunn & Dunn, 1978; Lou, Abrami, & d'Apollonia, 2001). Because the course had fifteen students enrolled, the groups were divided into four groups - three groups of four students and one group of three students.

Group 1 was a homogenous group with four females having similar learning styles but different disciplinary backgrounds. Group 2 was also a homogenous group with three females having similar content backgrounds and similar learning styles. Group 3, with four females, was a heterogeneous group given learning style, content background, and experience. Group 4 had three females and one male and was a homogenous group with balanced learning styles, but different backgrounds.

Students were responsible for accessing each week's lesson area in WebCT to review lesson content and complete assigned readings. Based on the lesson content, each student completed eight individual assignments during the course in order to prepare themselves for the team assignment and group discussions. After submission of individual assignments, each group collaborated to complete ill-structured, problem-based activities.

Team members communicated through WebCT's Discussion Forum, e-mail, and chat tools, as members preferred, in order to complete activities. Students also participated in weekly forum discussions facilitated by the course instructor. These weekly discussions were used to review and clarify lesson content.

As mentioned above, students communicated online to complete ten team activities. These student communications were observed to provide insight regarding group development. Students' interactions were observed and tracked only during week 2, 4, 6, 8, & 10. These five weeks present the lesson materials specifically designed to address varying learning styles.

The process each team followed to solve the case or the problem, the sharing of resources and ideas among team members, and the collaboration towards reaching an agreed solution were closely monitored. In addition, each team had a week to complete the activity, the final version of which was posted to the Discussion forum under the appropriate topic.

Each student was asked to keep a learning log during the semester which documented what course materials each student used to study or to prepare for assignments and tasks, what materials each student found most useful and why, and what materials each student wanted to have access to but did not find in the course weekly lesson. These logs were kept in the Discussion Forum area, with each student having a private topic area to use. Each student was also asked to rate individual group member participation in each weekly group activity.

Data Sources

The data was gathered from multiple sources to test the consistency of the findings. The following strategies used to gather data.

- Results of learning styles inventory
- Students' autobiographical papers
- Students' postings in collaborative team discussion area
- Teams' chat logs
- Teams' final responses (products) for each team activity
- Instructor's comments and feedback on team responses

Analysis Strategy

The data sources listed above were used in the analyses of this study. Each student's biographical sketch (which included a brief description of themselves, short-term and long-term academic and career goals, learning philosophy, expectations of the course, and the results of the Index of Learning Styles Questionnaire) was analyzed to identify student's learning style and use this information to assign each student to one of four collaborative groups.

Student interactions with their team members were analyzed using a coding scheme that was developed based on Tuckman's stages of group development model (1965) (see Appendix D – Coding Scheme). The unit of analysis for the coding scheme was a sentence rather than a phrase or the entire posting.

To create the coding scheme, first the characteristics for each of the 5 proposed categories of Forming, Storming, Norming, Performing, and Adjourning were outlined. These characteristics served as descriptions of the type of statements that would fall within each of the 5 categories. These characteristics described the nature and/or tone of the statement posted by

the student. For example, the general category of Forming was identified as “F”. Each characteristic within the category was then labeled numerically F1, F2, etc. (see Table 2 for examples of statements for each of the 5 stages).

Table 2. Examples of Forming, Storming, Norming, Performing, and Adjourning statements

Stage	Example posting for this stage
Forming	"Also, if no one has a problem with it I will be team leader this time. Since I didn't have a job last week I figured I should this time."
Storming	"I may have overreacted over frustration earlier and decided that my solution in a new organizer/date book with bigger blocks of space to fit my …requirements on as well."
Norming	"If you need more time, let us know, we will all work with you. We are still in the process of working out this group thing, and it will get better as the weeks go by!!
Performing	"Let's start the brainstorming process by each posting their individual ideas of how to complete the task with feedback from members."
Adjourning	"Thanks for everyone's hard work! This has been the most committed group that I have very worked with and I thank you guys for providing me with a positive group experience, since that is rare."

Before coding student interactions transcripts of each discussion forum for each of the four collaborative team discussions were downloaded and saved. All real names were removed from the transcripts and pseudonyms were assigned to protect the participants' identity (e.g. "John Doe" substituted with "T1-S1" indicating this student is in the first team and the first student.)

Using the printed transcripts and referencing the developed coding scheme, the researcher read each student's posting for the 5 chosen weeks. Each sentence in the posting was labeled to indicate the category and specific characteristic. For example, student T4-S1 posted "Please send me some feedback with improvements that I can make." In the margin next to the sentence, the researcher labeled this unit "P6", the code which describes a statement which may "provide or elicit feedback concerning task".

In addition to assigning a code to each statement, memos were noted to record the researcher's thoughts on the statement tone, student behavior, and overall trends of the student interactions.

After the coding of all postings, a spreadsheet was created to log team number, activity number, student name, posting statement, statement code, and learning style of the student who posted the statement. Researcher comments were logged as well.

Using the data logged in the spreadsheet, formulas were created to reveal trends in the discussions of each individual as well as the dynamics of the group. First, a formula was created to track the frequency of statements coded in each of the 5 categories. Data were gathered for each group. Frequency and percentages of statements coded as Forming, Storming, Norming, Performing, and Adjourning were analyzed based on the results of these formulas. The results were analyzed for trends suggesting the sequential pattern of group development. Each group's

trends were then compared to determine if the homogeneity or heterogeneity of the group was a factor in the pattern of development. Bar graphs were then created to visually represent the findings.

Similarly, data were gathered for each individual to determine frequency and percentage of a student's postings in each of Tuckman's suggested stages. Data were then analyzed for trends in the individual following or not following a sequential process of group development. Bar graphs were then created to visually represent the findings.

Coded data were then analyzed within the context of learning styles. Student data was compiled and divided by learning style into a separate spreadsheet. For example, all students who had scored within the "active" learner scale were grouped together and their data analyzed for trends indicating whether their progression (or lack of progression) may have been influenced by his/her learning style. Bar graphs were then created to visually represent the findings.

Providing another source of student interactions, transcripts of two of the four team's chat logs for weeks 2, 4, 6, 8, and 10 were also reviewed and analyzed for alignment with Tuckman's stages. The other 2 groups did not use the chat tool.

After the discussion forum and chat log transcripts were coded and analyzed, results of each student's learning styles index were again used to examine their role in each group's alignment or misalignment with Tuckman's model.

This chapter provided detail on how this study was conducted. Students' collaborative groups were formed based on autobiographical information. Their completion of tasks were observed, their statements coded, and interactions analyzed for trends relating to the variable of learning preferences. The following chapter details the findings based on the triangulation of this data.

CHAPTER FOUR

Findings and Discussion

The purpose of this study was to examine the effects of an individual's learning style on group development. Specifically, the researcher sought to answer the following questions:

1. How does an individual group member's learning style influence his/her group development process during online learning?
2. How does an individual group member's learning style contribute to the group's development during online learning?

As described in Chapter Two, research does not provide conclusive results on matching learning style with teaching style to promote learning. However, many researchers argue that teaching material in varying styles provides the learner an opportunity to expand his/her learning potential. In addition, many researchers agree that it may be more beneficial for individuals to work in a group containing individuals with different learning styles. They support the idea that providing an environment of differing approaches, views, and potential conflict may in the end benefit the learner.

The purpose of this study was, by answering the above questions, to discover the effect of learning styles in the formation of groups, in the individual's progression through group development, and in the progression of the group as a whole through linear stages of development. The following findings in this chapter are presented using these dimensions to provide meaningful organization.

Findings

Heterogeneous vs. Homogenous Group Formation

As detailed in Chapter 3, students were grouped into four teams. Three of the teams were categorized as homogenous because of team members' similarities in learning style. The remaining team was considered heterogeneous because of differences in learning styles and backgrounds of its members. The following section summarizes the findings of how each group's development aligned or misaligned with the model of sequential stage development.

Team 1 – Homogenous Group with similar learning styles but different backgrounds

Team 1 consisted of four team members with similar learning styles but different backgrounds. The team had the lowest number of total discussion postings at 159, due to their decision to meet weekly face-to-face to supplement online discussions to complete team assignments. This was the only team who chose to meet consistently face-to-face and did not use WebCT's Chat room tool. The analysis of the group's postings demonstrated that individual members had a high level of regard for one another. The following excerpts provide examples of such postings:

> *"Hey, you guys, we have a super team. It's gonna be a real pleasure on my part to work with you."*(posted by Student S4)
>
> *"Thanks you guys…we are a GREAT team!"*(posted by Student S1)

Team 1 had the highest number of postings categorized in the Forming stage of group development with 13% (20 postings) in this stage. Team 1 had the lowest number of postings in the Storming stage, with 8% (12 postings) in this stage. This team also had the highest number of Adjourning postings (4%) with 6 messages in this category.

During the team's first activity, 19 of the 79 discussion postings (24%) were in the Forming category. Because this was the first activity, it was expected that initial postings would be needed to become oriented with each other and to decide on roles, procedures, meetings, etc. towards the completion of the activity. However, none of the other three teams had close to this amount of Forming postings during their first activities. It is notable that for Team 1's subsequent activities, the postings in this category drop off to 0. Based on the overall quality of the team's completed products, it can be assumed that because of the initial level of forming behavior, the team was able to move more smoothly to the Performing stage of group development in subsequent activities.

Only one of the five completed products submitted by this team contained some content errors. Interestingly, the number of postings for the team's Activity 7 was the lowest of any activity, with only 8 total postings to supplement their face-to-face meeting. It could be predicted that had the communication been greater for this activity, perhaps the team members would have had the opportunity to produce a better product.

As mentioned, the quality of Team 1's products created during the other four activities was very good as measured by the instructor's comments and feedback. Postings further showed a sharing of ideas and resources as the team members sorted out ideas before developing the products. For example, the posting below illustrates a team member's point of view on the content of the assignment:

> *"While reading the information on these two learning theories it becomes evident that objectivism relies heavily on teacher directed, whole group instruction in which RIGHT answers are sought. Students are passive learners. According to [the instructor's] paper....one of the strategies of this traditional, many would*

refer to it as "old school", instruction method is a "bottom-up" approach. ....”

(posted by Student S2 during Activity 3)

The analysis suggested Team 1 consistently posted items similar to the above example, indicating that each member's point of view was considered prior to beginning the task. It appeared that once all team members had shared their understanding of the task and the lesson content upon which the activity was based, the team was then able to find a common ground and proceed to task completion procedures.

Team 2 – Homogenous Group with similar learning styles and similar backgrounds

Team 2 was formed with three team members with similar learning styles and backgrounds. Team 2 met face-to-face several times during the semester, but relied primarily on online discussion postings through the discussion forum. The Chat room was attempted as an alternative discussion tool, but was not used regularly due to technical problems. Team 2 had the highest number of discussion postings compared with other teams with 322 postings for the five activities. As with team one, this team also had a high number of postings during Activity 1 with 54% (173 postings) occurring during this first activity. Team 2 had few postings categorized in the Forming stage of group development, with only 2% (4 postings) in Activity 1 coded as Forming. This number dropped to 0 by Activity 5, and remained that low for all other remaining activities.

As opposed to Team 1, Team 2 began their collaboration in Activity 1 with a high percentage of postings categorized as Storming with 14% (24 postings) in the Storming stage. This number subsequently dropped down to between 1 and 3 postings in this stage for the rest of the activities. However, qualitative analysis of postings showed that many Storming postings were due to technical difficulties. For example:

"I like the collage idea, but am not computer savvy enough to invision (sic) how we would construct it and present it on the computer."

"Problem! I can not seem to access our chat room! Has anyone in the team tried to get in? Can anyone tell me how to?" (posted by Student S2 during Activity 1)

"I have been on the phone with Eduprise technical support since 8 trying to get the chat straight. No luck so far." (posted by Student S2 during Activity 1)

In addition to technical difficulties, other Storming postings were related to locating the 4th team member (who dropped the course before the beginning of Activity 1).

"I do hope [student] chimes in here soon because I am looking forward to her thoughts on the assignment." (posted by Student S2)

"[Student] has not responded at this point. I do hope she gets online this weekend. Do either of [you] know her? (posted by Student S2)

It is important to note that these postings were from the same group member. Because this was the first activity, again, it is not surprising to find a high level of Storming. Nevertheless, Team 2 progressed smoothly to Norming in the subsequent activities after initial technical problems were resolved and the question of the missing team member was answered. Team 2's postings in the Norming stage were consistent in all five activities, unlike the other teams.

Although Team 2 had their highest level of Storming in Activity 1, the overwhelming majority of postings for the initial activity were in the Performing stage – 131 out of the 173 postings (76%) were in this stage. Team 2 maintained a steady percentage of postings in the Performing stage throughout the five activities, with 67% (215 postings) in this stage. However, only 4 of the 322 total postings (1%) were in the final Adjourning stage.

Team 2's product quality was assessed as being excellent. The high quality of the team's products might have stemmed from a consistent sharing of ideas and resources and increased efficiency in completion of tasks. The quality of the product, the number of postings in the Performing stage, and the steady communication could also be attributed to the similarities in both learning styles and backgrounds.

Team 3 – Heterogeneous Group with differing learning styles and backgrounds

Team 3, with four team members, was formed with individuals of varying learning styles and backgrounds. Team 3 did not meet face-to-face to complete any of the activities, but was the only team to utilize WebCT's Chat room tool on a regular basis. With 175 total discussion postings through Activity 7, Team 3 had a low percentage of Forming postings with 5% (9 postings) in this category. Despite this low percentage, Team 3 had the second highest number of postings in the stage of Forming compared with Team 1.

Analysis of postings and chat room transcripts suggested that members of Team 3 were very supportive of one another. Their sharing of frustrations even on a personal level seemed to help the team members connect with one another.

Team 3 had the lowest percentage of total postings in the Norming stage with just 8% (14 postings). Activity 1 had 12% (10 postings) in this stage, with a drop off to 5% (2 postings) and then eventually 0%. However, Team 3 did have the highest percentage of postings overall in the Performing stage with 69% (121 postings) of their total postings for the 5 activities categorized in this stage of group development.

The quality of the products produced by Team 3 was assessed to be fair. Based on instructor feedback of their activities, this team should have started collaboration earlier during

each activity to allow more time for its completion, didn't include necessary components of the assignment, and had some content errors in one of the activities.

All four team members were participating up until Activity 5. By Activity 7, only 2 of the 4 members remained in the group after students T3-S2 and T3-S4 dropped the course for personal reasons. It might have been the reason that the team's product for this activity had content errors.

Although this team did not stay together to the end of the course, based on qualitative analysis of the postings, it can be predicted that this team would have had a high rate of success for the rest of the activities if its members had not been plagued by personal and employment related influences.

Team 4 – Homogenous Group with similar learning styles

Team 4 consisted of four members with similar learning styles but mainly balanced in several areas. This team had the second highest number of postings with 313. Of these postings, only 4% (12 postings) were categorized in the Forming stage of group development. During their first activity, 7% (8 postings) were Forming, dropping down to 6%, 1%, and then 0% in subsequent activities. There was little up-front organization by this team in terms of role and task assignment.

Team 4 had the highest percentage of total postings in the Storming stage of group development with 24% (75 postings) of their total posts in this stage. In fact, in each of the five activities examined in the study, Team 4 had the highest percentage of Storming compared to the other three groups. The postings categorized as Storming were due to frustration with team members, confusion over task and role, and conflict over procedures.

Below are examples of postings which demonstrate some frustration with fellow team members:

"Discussion is encouraged, but can't be done at the last minute, on assignment 4 you raised some excellent points for discussion, but then attempts to discuss those matters were never followed through with."

"I am not opposed to it and I will go with the team but I think we need to feel free to express our opinions--even though it would be so much easier to have this discussion face to face." (posted by Student S2)

By Activity 5, which is in the middle of the semester, Team 4 was still not effectively functioning in terms of task and role delegation. During this activity, team members reached their highest level of storming at 30% (31 postings) - with most of the Storming postings related to role assignments and task completion procedures. Both of these areas should have been agreed to and resolved in the beginning of the semester during their initial collaboration.

Below are examples of postings which showed confusion as to the responsibilities of the Leader and Recorder roles of the team, as well as the schedule for task completion:

"[Student S1] submitted assignment 4 this am, we had agreed earlier that once an assignment was submitted, then the next team leader could start the thread for new assignment."

"We have set the deadline of Thursday night for individual submissions several times to allow the recorder ample time to finish project and post it."

"This is what we as a team have agreed on several times. Discussion regarding division of assignments need to be done prior to the Sunday deadline, Discussion

regarding individual assignments content needs to be done prior to the Thursday deadline." (posted by Student S2)

"I am confused about the roles that we have devloped (sic) as Leader and Recorders. Maybe we are giving ourselves too much responsibility (sic) because according to the parameters of the class… the roles are Team Leader "is in charge of keeping time and making sure that everyone participates" and the Team Recorder "has the responsibility of keeping record of what is said and posting the team's response". Are we interpreting the leader's role of "keeping time" to assigning HOW an assignment is completed? I'm just wondering if the two have meshed because in order to keep time we need to begin to do SOMETHING but again I am concerned that we are all not hearing each other before we begin to jump into it."(posted by Student S4)

It is important to note that the majority of Storming postings during the life of this team were from two of the team members reflecting their frustration with each other and that these two team members had similar learning styles.

One team member (T4-S1) did not get directly involved in these exchanges, but rather attempeds to mediate the conflict, as evidenced in the posting below:

"…I just want everyone to understand that [the instructor] has been very complimentary of our group, I think while we are all scrambled b/c we have different times during the week that we can work we are still doing a good job. Just my 2 cents." (posted by Student T4-S1)

Student T4-S3 suppresses her conflict by avoiding direct response to postings which were potentially provocative. For example, after the leader of Activity 1 posted several bold

statements regarding how the roles should be divided and how the tasks should be accomplished (all without team input), the team member responded only with *"OK, I give, I'll combine the slides."* (posted by Student T4-S3)

Compared to a steadier decline and leveling off of postings of the other three groups, the quantity of Team 4's postings per activity fluctuated during the five activities. Team 4 had 122 postings during Activity 1, decreasing to 52 postings for Activity 3, increasing again to 104 postings for Activity 5 (with the highest Storming rate here), and dropping down to only 8 postings for the final activity. It is evident in these final postings that all four team members simply want to complete the activity and disband the group as quickly as possible. This was also demonstrated by the complete absence of any postings categorized as Adjourning.

Despite their high ratio of postings in the Storming stage, Team 4 developed excellent products for each of their activities. Feedback from the instructor on their work included remarks on their impressive detail, good organization, excellent analysis, and demonstration of deep understanding of the content material.

Summary of Findings of Learning Styles Effect on the Formation of Homogenous and Heterogeneous Groups

The heterogeneous Team 3 experienced the loss of 3 out of its original 4 team members which prohibited a completely parallel examination of their collaboration to the other 3 teams. In terms of product quality, the heterogeneous Team 3 had the most content errors, but still produced good work. Additionally, it is clear that team members were very supportive of one another both personally and during completion of tasks. With the highest percentage overall of postings in the Performing stage (69%) it can be assumed that if the team had stayed together and been provided an opportunity to continue collaboration, that the products may be improved.

The homogeneous groups were not without some content errors, but overall produced better work. Two of the three groups had low Storming percentage totals, with the third group (Team 4) experiencing an extremely high storming rate in comparison due to conflicts between 2 team members.

Based on this analysis, it does not appear that forming groups with similar or different learning styles directly influences the quality of work in this setting or the group's progression through sequential stages of group development.

Individual Learning Styles and Group Development

In addition to examining homogeneous and heterogeneous group formation with regarding to individual learning styles, another dimension for analysis in this study is the examination of learning styles and individual progression through group stage development.

For the purpose of this study, only two of Felder's learning style dimensions were used in examining the effect of learning styles on group development – the Active/Reflective dimension and the Sequential/Global dimension.

When examining team member progression through Tuckman's stages of group development, assumptions were made regarding the expected characteristics of Active/Reflective and Sequential/Global learners. Table 3 illustrates these assumptions.

Table 3: Assumptions of learning style characteristics.

Learning Style	Characteristics in group development
Active	• Task oriented • Discuss and apply information (prefer to do something with the information) rather than just do nothing • Like to try and see how it works
Reflective	• Think quietly before contributing • Prefer to think it through • Prefer working alone rather than in groups
Sequential	• Gain understanding in linear steps • May not fully understand content but can still do something with it
Global	• Learn in large jumps • Learn randomly then just "get it" • Solve problems quickly but have trouble explaining how they accomplished it • Have difficulties until they get the big picture

Based on these assumptions, the following are findings regarding each individual and his/her progression through sequential stages of group development.

Table 4: Individual posting activity

Student	Activity	Postings in Forming		Postings in Storming		Postings in Norming		Postings in Performing		Postings in Adjourning	
Active & Sequential Learning Styles											
T1-S2	Activity 1	4	50%	0	0%	2	25%	2	25%	0	0%
	Activity 3	0	0%	0	0%	1	14%	6	86%	0	0%
	Activity 5	1	33%	0	0%	0	0%	2	67%	0	0%
	Activity 7	0	0%	0	0%	0	0%	0	0%	0	0%
	Activity 10	0	0%	0	0%	0	0%	0	0%	1	100%
T1-S4	Activity 1	13	28%	4	9%	11	23%	19	40%	0	0%
	Activity 3	0	0%	1	5%	5	25%	14	70%	0	0%
	Activity 5	0	0%	1	17%	1	17%	4	67%	0	0%
	Activity 7	0	0%	0	0%	0	0%	2	100%	0	0%
	Activity 10	0	0%	0	0%	2	18%	8	73%	1	9%
T3-S2	Activity 1	1	8%	2	15%	5	38%	5	38%	0	0%
	Activity 3	1	7%	2	14%	0	0%	10	71%	1	7%
	Activity 5	0	0%	0	0%	0	0%	2	100%	0	0%
	Activity 7	0	0%	0	0%	0	0%	0	0%	0	0%
Active/Reflective & Sequential											
T1-S1	Activity 1	1	8%	1	8%	4	33%	6	50%	0	0%
	Activity 3	0	0%	0	0%	0	0%	0	0%	0	0%
	Activity 5	0	0%	0	0%	0	0%	3	100%	0	0%
	Activity 7	0	0%	2	67%	0	0%	1	33%	0	0%
	Activity 10	0	0%	0	0%	1	33%	2	67%	0	0%
T2-S1	Activity 1	2	4%	10	18%	4	7%	40	70%	1	2%
	Activity 3	0	0%	1	4%	6	24%	18	72%	0	0%
	Activity 5	0	0%	0	0%	4	33%	8	67%	0	0%
	Activity 7	0	0%	1	5%	6	27%	15	68%	0	0%
	Activity 10	0	0%	0	0%	3	50%	3	50%	0	0%
T2-S2	Activity 1	1	2%	11	17%	7	11%	44	70%	0	0%
	Activity 3	3	16%	1	5%	5	26%	10	53%	0	0%
	Activity 5	0	0%	0	0%	1	33%	2	67%	0	0%
	Activity 7	0	0%	1	13%	2	25%	5	63%	0	0%
	Activity 10	1	11%	1	11%	3	33%	3	33%	1	11%

T4-S4	Activity 1	0	0%	9	47%	2	11%	8	42%	0	0%
	Activity 3	0	27%	4	27%	0	0%	11	73%	0	0%
	Activity 5	0	0%	15	42%	2	6%	19	53%	0	0%
	Activity 7	0	0%	0	0%	1	9%	10	91%	0	0%
	Activity 10	0	0%	0	0%	0	0%	2	100%	0	0%
Active/Reflective & Sequential/Global											
T4-S2	Activity 1	3	6%	3	6%	17	36%	24	51%	0	0%
	Activity 3	1	13%	1	13%	0	0%	6	75%	0	0%
	Activity 5	0	0%	15	31%	1	2%	32	67%	0	0%
	Activity 7	0	0%	0	0%	0	0%	9	100%	0	0%
	Activity 10	0	0%	0	0%	0	0%	2	100%	0	0%
T4-S3	Activity 1	4	10%	13	31%	5	12%	20	48%	0	0%
	Activity 3	1	7%	3	20%	3	20%	8	53%	0	0%
	Activity 5	0	0%	0	0%	2	14%	12	86%	0	0%
	Activity 7	0	0%	2	40%	0	0%	3	60%	0	0%
	Activity 10	0	0%	0	0%	0	0%	3	100%	0	0%
Active & Sequential/Global											
T1-S3	Activity 1	1	8%	0	0%	2	17%	8	67%	1	8%
	Activity 3	0	0%	1	20%	3	60%	1	20%	0	0%
	Activity 5	0	0%	1	33%	0	0%	2	67%	0	0%
	Activity 7	0	0%	0	0%	0	0%	2	67%	1	33%
	Activity 10	0	0%	0	0%	0	0%	3	75%	1	25%
T3-S4	Activity 1	0	0%	5	38%	0	0%	8	62%	0	0%
	Activity 3	0	0%	0	0%	0	0%	4	100%	0	0%
	Activity 5	1	13%	0	0%	1	13%	6	75%	0	0%
T4-S1	Activity 1	1	7%	3	21%	5	36%	5	36%	0	0%
	Activity 3	1	7%	4	29%	2	14%	7	50%	0	0%
	Activity 5	1	17%	1	17%	2	33%	2	33%	0	0%
	Activity 7	0	0%	2	100 %	0	0%	0	0%	0	0%
	Activity 10	0	0%	0	0%	0	0%	1	100%	0	0%
Reflective & Sequential/Global											
T2-S3	Activity 1	1	2%	3	6%	2	4%	47	89%	0	0%
	Activity 3	1	8%	0	0%	5	38%	6	46%	1	8%
	Activity 5	0	0%	1	8%	5	42%	6	50%	0	0%
	Activity 7	0	0%	1	10%	2	20%	7	70%	0	0%
	Activity 10	0	0%	0	0%	8	80%	1	10%	1	10%
T3-S3	Activity 1	1	7%	1	7%	0	0%	13	87%	0	0

	Activity 3	0	0%	1	13%	0	0%	7	88%	0	0%
	Activity 5	1	7%	3	20%	1	7%	10	67%	0	0%
	Activity 7	0	0%	3	43%	0	0%	4	57%	0	0%
Active & Global											
T3-S1	Activity 1	1	3%	6	15%	5	13%	28	70%	0	0%
	Activity 3	2	17%	2	17%	2	17%	6	50%	0	0%
	Activity 5	0	0%	2	15%	0	0%	11	85%	0	0%
	Activity 7	1	9%	1	9%	0	0%	7	64%	2	18%
	Activity 10	0	0%	1	17%	0	0%	4	67%	1	17%

The learning styles of each team member were considered as a variable in his/her progression through the linear stages of group development proposed by Tuckman (1965). Based on the findings detailed in Table 4, only 4 of the 15 students (Students T1-S4, T4-S2, T1-S3, and T3-S1) showed trends towards progressing through the Forming, Storming, Norming, Performing, and Adjourning stages of group development.

Interestingly, the 4 students who did show trends towards sequential group development each had different learning styles.

It could be expected that students scoring higher on the Sequential dimension of Sequential/Global scale of learning styles would be more likely to progress through linear stages of development consistently through the life of the team. However, that was not suggested by the data. Rather, of the 7 students who scored clearly as a Sequential learner (students T1-S2, T1-S4, T3-S2, T1-S1, T2-S1, T2-S2, T4-S4), only 1 student (T1-S4) showed a pattern of group development. In addition, the remaining 11 students showed no tendencies towards progressive group development as proposed by Tuckman (Students T1-S2, T3-S2, T1-S1, T2-S1, T2-S2, T4-S4, T4-S3, T3-S4, T4-S1, T2-S3, and T3-S3).

Group Progression through Stages of Group Development

The next area of analysis was whether each of the 4 groups progressed through the stages of Forming, Storming, Norming, Performing, and Adjourning. Each Team's development was examined both by each activity and then for trends across the activities.

Team 1, whose members primarily met face-to-face, consistently created quality products developed in a truly collaborative environment. Because the majority of team interactions were not recorded in the discussion forum or in the chat area, it is impossible to estimate the degree to which this team's interactions fell within the initial stages of Forming, Storming, and Norming.

However, based on available discussion postings, there was a tendency in this team to follow Tuckman's stages of group development. This team had the highest rate of postings coded as Forming and continued a consistent trend of posts in the Storming (though only 8%), Norming, and Performing, with a low rate of Adjourning (*Note: 2 of the 4 team members did show individual tendencies towards group development)*.

Team 2's postings demonstrated a high regard for team members and an effort to share ideas and resources towards the completion of activities. This team showed a slight tendency to follow Tuckman's linear stage development process. Though Team 2's ratio of Forming and Adjourning postings was lower than Team 1's, they did exist, with an overwhelming amount of postings in the Performing stage. (*Note: None of the team members progressed individually through the stages of group development*).

Team 3 began its initial collaboration on Activity 1 showing tendencies towards following a linear pattern of group development. However, that pattern dissolved as 3 out of the 4 team members left the group after dropping the course. Even before the students dropped, participation in online discussions decreased, though the ratio for Performing was high. No definitive pattern has emerged which is parallel to Tuckman's model. (*Note: Only 1 of the 4 team members showed individual tendencies towards following a stage development process*).

Team 4, despite its 313 postings and consistent, high quality products, did not follow a pattern of linear progression of stage development as suggested by Tuckman. Only 12 of the 313 postings were in the Forming category, with 0 in the Adjourning category. This team had trouble going from the Storming stage into Norming, having only truly reached this stage in Activity 1. (*Note: Only 1 of the 4 team members showed individual tendencies towards following a stage development process*).

During qualitative analysis, the researcher noted trends in the tone of the postings and the interactions of students which could be attributed to other factors. For example, the older students (in their 40s and 50s) consistently posted statements which were stronger in tone, more directly addressed the task at hand, and could have been construed as impolite. These same students were also more likely to assume a leadership role even though they were not the leader for a specific activity.

In contrast to the older students, the younger students posted statements which were more tentative in tone, showed less confidence in the task and their role, and were more polite as not to offend. Rather, the younger students often posted statements which seemed to suggest they were avoiding conflict by not directly addressing other potentially provocative postings.

Summary of Group Progression through Stages of Development

Two of the four groups show tendencies towards following Tuckman's suggested linear progression of Forming, Storming, Norming, Performing, and Adjourning. Though a group's total postings and overall ratios may point to a pattern, when each team activity was examined for trends, it was apparent that there was not enough consistency to declare they followed a linear pattern.

No relationship between team member learning style to the group's overall tendency was apparent. For example, though none of Team 2's members showed individual patterns of following linear stages of development, the group as a whole did show a slight tendency to progress through the suggested stages of group development.

A summary of findings (Table 5: Impact of Individual Learning Styles on Product Quality and Postings and Table 6: Impact of Individual Learning Styles on Group Development) are shown on the pages that follow.

Table 5: Impact of Individual Learning Styles on Product Quality and Postings

Team	Team Category	Product Quality	Postings
Team 1 • T1-S1: Active/Reflective learner and Sequential learner • T1-S2: Active learner and Sequential learner • T1-S3: Active learner and Sequential/Global learner • T1-S4: Active learner and Sequential learner	• Homogenous • Similar Learning Styles • Different Backgrounds	• Very good product quality as measured by instructor's comments and feedbacks • Only 1 of 5 completed products had content errors	• Lowest total postings (159)(met face-to-face) • Highest number of Forming postings (20 – 13%) • Lowest number of Storming postings (12 – 8%) • Highest Adjourning postings (6-4%) • High regard for team members • Sharing of ideas and resources to reach consensus of task solution • 24% of 1st activity's postings were forming (lower in subsequent activities • Moved smoothly to Performing stage in later activities
Team 2 • T2-S1: Active Reflective learner and Sequential learner • T2-S2: Active/Reflective learner and Sequential learner • T2-S3: Reflective learner and Sequential/Global learner	• Homogeneous • Similar learning styles • Similar backgrounds	• Product quality assessed by instructor as excellent	• Highest number of total postings (322) • 54% of postings were during Activity 1 • Only 4 total Forming postings (2%) occurred in Activity 1High percentage of Storming postings (24 – 14%) in Activity 1; dropped to between 1 and 3 for rest of activities • Norming postings consistent in all activities • Had 215 (67%) of

			postings in Performing stage • 4 (1%) of postings in Adjourning • Consistent sharing of ideas and communication • Increased efficiency in task completion with each activity
Team 3 • T3-S1: Active learner and Global learner • T3-S2: Active learner and Sequential learner • T3-S3: Reflective learner and Sequential/Global learner • T3-S4: Active learner and Sequential/Global learner	• Heterogeneous • Different learning styles • Different backgrounds	• Product quality fair as measured by instructor's comments and feedback • 3 of 4 team members dropped class by Activity 7	• Low Forming postings (9 – 5%) • Second highest number of Forming postings • Lowest Norming postings (14 – 8%) • Highest overall Performing postings (121 – 69%)
Team 4 • T4-S1: Active learner and Sequential/Global learner • T4-S2: Active/Reflective learner and Sequential/Global learner • T4-S3: Active/Reflective learner and Sequential/Global learner • T4-S4: Active/Reflective learner and Sequential learner	• Homogeneous • Similar learning styles • Balanced in other areas	• Excellent product quality based on instructor's feedback	• Second highest total postings (313) • 12 Forming postings (4%) • Highest Storming postings (75 – 24%) • Activity 5 had 31 (30%) Storming postings

Table 6: Impact of Individual Learning Styles on Group Development

Team	Team Category	Group Development
Team 1 • T1-S1: Active/Reflective learner and Sequential learner • T1-S2: Active learner and Sequential learner • T1-S3: Active learner and Sequential/Global learner • T1-S4: Active learner and Sequential learner	• Homogenous • Similar Learning Styles • Different Backgrounds	• Tendency in this team to follow Tuckman's stages of group development. • This team had the highest rate of postings coded as Forming and continued a consistent trend of posts in the Storming (though only 8%), Norming, and Performing, with a low rate of Adjourning • Students T1-S4 and T1-S3 had showed individual patterns of following sequential group development
Team 2 • T2-S1: Active Reflective learner and Sequential learner • T2-S2: Active/Reflective learner and Sequential learner • T2-S3: Reflective learner and Sequential/Global learner	• Homogeneous • Similar learning styles • Similar backgrounds	• This team showed a slight tendency to follow Tuckman's linear stage development process. Though Team 2's ratio of Forming and Adjourning postings was lower than Team 1's, they did exist, with an overwhelming amount of postings in the Performing stage. • No team members showed patterns of sequential group development
Team 3 • T3-S1: Active learner and Global learner • T3-S2: Active learner and Sequential learner • T3-S3: Reflective learner and Sequential/Global learner • T3-S4: Active learner and Sequential/Global	• Heterogeneous • Different learning styles • Different backgrounds	• Supportive • Sharing of personal information • No definitive pattern has emerged which is parallel to Tuckman's model • Student T3-S1 showed individual pattern of following sequential group development

learner		
Team 4 • T4-S1: Active learner and Sequential/Global learner • T4-S2: Active/Reflective learner and Sequential/Global learner • T4-S3: Active/Reflective learner and Sequential/Global learner • T4-S4: Active/Reflective learner and Sequential learner	• Homogeneous • Similar learning styles • Balanced in other areas	• Little up-front organization of role and task assignment • Confusion over task and role, conflict over procedures, frustration with team members • Quantity of postings fluctuated • despite its 313 postings and consistent, high quality products, did not follow a pattern of linear progression of stage development • Student T4-S2 showed individual pattern of following sequential group development

Discussion

The topic for this study was conceived from the researcher's interest in how individuals function when formed into a group to accomplish tasks. As a student, I did not consider the possibility that groups could be formed to enhance my learning experience. Rather, the selection of classmates to work together appeared random, though perfectly acceptable. However, from both the educator and instructional designer perspectives, it became clear that group formation should be based on a more logical and thoughtful approach.

As a means of investigating the factor of learning styles as a consideration in such an approach, this study examined the interactions and processes of individuals collaborating in an online environment. Many studies have examined the impact of tailoring instruction to cater to these learning styles. However, the findings of this study do not indicate individual learning styles were a determiner of individual or group progression through Bruce Tuckman's 5 sequential stages of group development.

More specifically, the 4 collaborative groups were formed based primarily on the student's results from the Index of Learning Styles Questionnaire. Though other factors were considered for group formation (e.g. experience and disciplinary background), learning style was the determining factor to form homogeneous and heterogeneous groups. Based on the results of this study, it does not appear that the formation of groups based on student learning style is a predictor of the individual's or the group's following a sequential pattern towards group development. Similarly, the tendency of the student or the group as a whole to develop sequentially did not appear to be determined by working with other students either with similar or with different learning styles from their own.

In conducting this study in a naturalistic environment, the researcher was unable to rule out other factors that could have possibly contributed to the success or failure of a group (and the individual) to progress sequentially from Forming to Adjourning. This course was open for enrollment to students from several graduate programs. The students from these programs offered a variety of ages, personalities, backgrounds, and experiences. These factors could have influenced the success or failure of the group to develop as proposed in Tuckman's model.

In addition, postings demonstrated some differences that could have been based on their backgrounds and experiences. For example, students with more experience were more likely to post task-oriented statements which indicated a preference for progressing to the Performing stage more quickly. In contrast, students with less experience posted more tentative statements which indicated their preference for deferring to the more experienced classmates and showed difficulty in approaching the complexity of tasks.

There are implications of these findings to the design of instruction. These findings suggest that the stages of group development measured by Tuckman are not influenced when groups are formed primarily by student learning styles. Many educators and instructional designers employ groups as part of an instructional strategy. With the goal of choosing a strategy to help the learner achieve the instructional objectives, the selection of which individuals should work together was assumed to have a potential impact on meeting these objectives.

Moreover, this study suggests learning styles may be ruled out as a determiner for the quality of work produced within a team. Both the heterogeneous team and the homogeneous teams had comparable work quality despite the team member's learning styles.

Though an argument could be made in favor of random group formation achieving comparable or even more favorable results, it does a disservice to the student not to consider the

complexity of issues in placing him/her within a group of peers in a learning environment. As mentioned above, instructional strategies are chosen to help the learners meet the instructional objectives. If this is to be true, then it is imperative the educator/instructional designer consider the multiple perspectives that form a student's approach in a learning environment. For example, an instructional designer should consider a student's profile including his/her age, disciplinary background and work experience.

In addition to these characteristics, an instructional designer should allow time prior to the beginning of instruction for the student to complete inventories which identify personality type, leadership style, and thinking style. The accessibility of online surveys allows for these assessments to be completed easily and quickly.

Finally, the complexity of tasks to be completed should also be considered as a factor when forming groups. Perhaps a group formed with similar styles and backgrounds is more successful for simple tasks, but a group formed with a variety of styles and backgrounds is more successful for higher level, problem-solving tasks.

Based on the qualitative analysis of the groups' interactions, the tone of the postings, and the complexity of tasks to be completed in this study, these additional factors warrant consideration. Future studies should examine, in a more experiential environment, the possibility that one or more of these variables could possibly affect group development in an online environment.

LITERATURE CITED

Association for Educational Communications and Technology. (2003). Distance Education Definition and Glossary of Terms. Bloomington, IN.

Bales, R.F. (1951) *Interaction process analysis: A method for the study of small groups*. Reading, MA: Addison-Wesley Press, Inc.

Baron, R.S., Moore, D., & Sanders, G.S. (1978). Distraction as a source of drive in social facilitation research. *Journal of Personality and Social Psychology, 36*, 816-824.

Barton, W. A., Jr. (1926). The effect of group activity and individual effort in developing ability to solve problems in first-year algebra. *Journal of Educational Administration and Supervision, 12*, 512-518.

Beaty, W.E. & Shaw, M.E. (1965). Some effects of social interaction on probability learning. *Journal of Psychology, 59,* 299-306.

Bonner, H. (1959). *Group dynamics: principles and applications*. New York, NY: Ronald Press Co.

Burtt, H.E. (1920) Sex differences in the effect of discussion. *Journal of Experimental Psychology, 3,* 390-395.

Canfield, A. (1980). *Learning styles inventory manual*. Ann Arbor, MI: Humanics Media.

Cartwright, Dorwin & Zander, Alvin. (1953). *Group dynamics, research and theory*. Evanston, IL: Row, Peterson

Chadwick, S. (1999). Teaching Virtually via the Web: Comparing Student Performance and Attitudes About Communication in Lecture, Virtual Web-Based, and Web-Supplemented Courses. *The Electronic Journal of Communication, 1.* Retrieved February 9, 2005, from http://www.cios.org/getfile/Chadwick_v9n199.

Comeaux, P. (2002). *Communication and Collaboration in the Online Classroom*. Bolton, MA: Anker Publishing Company, Inc.

Comeaux, P. & Nixon, M.A. (2000). Collaborative Learning in an Internet Graduate Course: A Case Study Analysis. *WebNet Journal*, October-December.

Cottrell, N.B. (1972). Social facilitation. In C.G. McGlintock (Ed.), *Experimental social psychology* (pp. 185-236). New York: Holt, Rinehart, and Winston.

Davie, L.E. & Wells, R. (1991). Empowering the learner through computer-mediated communication. *American Journal of Distance Education, 5* (1) 15-23.

Daugherty, M. and Turner, J. (2003). Sociometry: An approach for assessing group dynamics in web-based courses. *Interactive Learning Environments, 11* (3), 263-275.

Denig, S. (2004). Multiple Intelligences and Learning Styles: Two Complementary Dimensions. *Teachers College Record, 106* (1), 96-111.

Dunn, R.S. & Dunn, K. (1978). Teaching students through their individual learning styles: a practical approach. Reston, VA.: Reston Publishing Co.

Durkheim, E. (1964) *The division of labor in society*. New York, NY: Free Press.

Eastmond, D.V. (1992). Effective facilitation of computer con-ferencing. *Continuing Higher Education Review, 56,* 155-167.

Entwistle, N. (1988) Motivational Factors in Students' Approaches to Learning. In Schmeck, R.R. (Ed.), *Learning Strategies and Learning Styles*, New York, NY: Plenum Press.

Felder, R.M. & Silverman, L.K. (1988). Learning and Teaching Styles in Engineering Education. *Engineering. Education, 78* (7), 674-681.

Felder, Richard M. (1996). Matters of Style. *ASEE Prism*, *6* (4), 18-23.

Forsyth, Donelson R. (1983). *An introduction to group dynamics*. Monterey, CA:

Brooks/Cole Pub. Co.

Forsyth, Donelson, R. (1990). *Group Dynamics* (2nd ed.). Pacific Grove, CA.: Brooks/Cole Pub. Co.

Gilbert, L. & Moore, D. (1998) Building Interactivity into Web Courses: Tools for Social and Instructional Interaction. *Educational Technology, 38* (3), 29-35.

Graham, C.R. (2002). Factors for effective learning groups in face-to-face and virtual environments. *The Quarterly Review of Distance Education, 3* (3), 307-319.

Graham, C.R. (2003). A model of norm development for computer-mediated teamwork. *Small Group Research, 34* (3), 322-352.

Grasha, A. F. (1996). Teaching with style. Pittsburgh, PA: Alliance.

Hallock, D., Satava, D., & LeSage, T. (2003). An exploratory investigation of the potential relationship between student learning styles, course grade, cumulative grade point average and selected demographics in on-line undergraduate business courses. *Management Research News, 26* (1) 21-28.

Hare, P. and Naveh, D. (1984), Group development at the Camp David Summit*, Small Group Behavior, 15* (3), 299-318.

Heffler, B. (2001) Individual Learning Style and the Learning Style Inventory. *Educational Studies, 27* (3), 307-316.

Hiltz, S.R. (1997). Impacts of college-level courses via asynchronous learning networks: Some preliminary results. *Journal of Asynchronous Learning Networks, X.* Retrieved October 30, 2004, from http://www.aln.org/alnweb/journal/issue2/hiltz.htm

Homans, G.C. (1950). *The human group*. New York, NY: Harcourt, Brace, & World.

Horton, W. (2000). *Designing Web-Based Training: How to teach anyone anything*

anywhere anytime. New York, NY: John Wiley & Sons, Inc.

Husband, R.W. (1940) Cooperative versus solitary problem solution. *Journal of Social Psychology, 11*, 405-409.

Johnson, D.W. & Johnson, F.P. (1997). Joining together: Group theory and group skills. Boston, MA.: Allyn and Bacon.

Jonassen, D.H. & Grabowski, B.L. (1993). *Handbook of Individual Differences, Learning & Instruction.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Jonassen, D.H., & Kwon, H.I. (2001). Communication patterns in computer-mediated versus face-to-face group problem solving. *Educational Technology Research and Development*, *49* (1), 35-51.

Kanekar, S., & Rosenbaum, M.E. (1972). Group performance on a multiple-solution task as function of available time. *Psychonomic Science, 27*, 331-332.

Kemp, J. E., Morrison, G. R., & Ross, S. M. (1998). *Designing effective instruction* (2nd ed.). Upper Saddle River, NJ: Merrill.

Kim, J. and Michael, W.B. (1995). The Relationship of Creativity Measures to School Achievement and to Preferred Learning and Thinking Style in a Sample of Korean High School Students. *Educational and Psychological Measurement, 55* (1), 60-74.

Kolb, D.A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.

Lawrence, G. (1982). People types and tiger stripers: A practical guide to learning styles. Gainesville, FL.: Center for Applications of Psychological Type.

Lewin, K. (1948). *Resolving social conflicts*. New York, NY: Harper.

Lou, Y., Abrami, P. C., & d'Apollonia, S. (2001). Small group and individual

learning with technology: A meta-analysis. *Review of Educational Research, 71* (3), 449–521.

Lu, J., Yu, C.S., & Liu, C. (2003). Learning style, learning patterns, and learning performance in a WebCT-based MIS course. *Information & Management, 40*, 497-507.

Lurey, J. S. & Raisinghani, M. S. 2001. An empirical study of best practices in virtual teams. *Information and Management*, *38,* 523-544.

MacClintic, S.D. & Nelson, G.M. (1996). Gender and group dynamics. Workshop held October 18, 1996

Marston, W.M. (1924) Studies in testimony. *Journal of Criminal Law and Criminology, 15*, 5-31.

Marton, F. (1988) Describing and improving learning. In Schmeck, R.R. (Ed.), *Learning Strategies and Learning Styles*. New York, NY: Plenum Press.

Marton F. & Saljo, R. (1976). On qualitative differences in learning: I. Outcome and process. *British Journal of Educational Psychology*, *46*, 4-11.

Marukus, H. (1978). The effect of mere presence on social facilitation: An unobtrusive test. *Journal of Experimental Social Psychology, 14*, 389-397.

McLoughlin, C. (1999). Culturally responsive technologies use: developing an on-line community of learners. *British Journal of Educational Technology, 30,* 231-243.

Moallem, M. (2002). Designing and implementing an interactive online learning environment. In Comeaux, Patricia. *Communication and collaboration in the online classroom*. Bolton, MA., Anker Publishing Company, Inc.

Pask, G. (1976). Styles and strategies of learning. *British Journal of Educational Psychology*

46, 128-48.

Pask, G. (1988). Learning strategies, teaching strategies and conceptual or learning style. In Schmeck, R.R. *Learning strategies and learning styles.* New York, NY: Plenum Press.

Perlmutter, H.V. & de Montmollin, G. (1952). Group learning of nonsense syllables. *Journal of Abnormal and Social Psychology, 47*, 762-769.

Rasmussen, K. L. (1998). Hypermedia and learning styles: Can performance be influenced*?* *Journal of Multimedia and Hypermedia 7* (4), 291-308.

Riding, R., & Grimley, M. (1999). Cognitive style and learning from multimedia materials in 11-year children. *British Journal of Educational Technology 30* (1), 43-59.

Riding, R. & Rayner, S. (1999). Cognitive styles and learning strategies: Understanding style differences in learning and behavior. London, England: David Fulton Publishers.

Rothwell, J.D. (2004). *In mixed company: Communicating in small groups and teams* (5th ed). Belmont, CA: Wadsworth.

Sabry, K. & Baldwin, L. (2003). Web-based learning, interaction, and learning styles. *British Journal of Educational Technology 34* (4), 443-54.

Saracho, O.N. (1993). The effects of the teachers' cognitive styles on their students' academic achievement. *International Journal of Early Childhood 25* (2), 37-40.

Schmeck, R.R. (Ed.). (1988). *Learning strategies and learning styles*. New York, NY: Plenum Press.

Schutz, W. (1966). *The Interpersonal Underworld*., Palo Alto, CA: Science and Behavior Books

Shaw, M.E. (1981). *Group dynamics: the psychology of small group behavior* (3rd ed). New

York,NY: McGraw-Hill.

Shedletsky, L.J. (1993). Minding computer-mediated communication: CMC as experiential learning. *Educational Technology*, *33* (12), 5-10.

Shepperd, J. A. (1993). Productivity loss in performance groups: A motivation analysis. *Psychological Bulletin, 113*, 67-81.

Shimoda, T.A. & Takayesu, J.K. (1997). *Individual roles and group dynamics in a problem-based learning classroom: Generating and evaluating skill-oriented learning objectives*. Paper presented to Annual Meeting of the American Educational Research Association, Chicago, Illinois.

Smith, K.K. & Berg, D.N. (1987). *Paradoxes of group life: Understanding conflict, paralysis, and movement in group dynamics* (1st ed.) San Francisco, CA: Jossey-Bass.

Soloman, B.A. & Felder, R.M. (1998) Index of Learning Style Questionnaire. Retrieved August 30, 2004 from http://www.engr.ncsu.edu/learningstyles/ilsweb.html.

Stogdill, R.M. (1959). *Individual behavior and group achievement*. New York, NY: Oxford.

Tennant, M. (1997). *Psychology and adult learning* (2nd ed.) New York, NY: Routledge

Tuckman, J., & Lorge, I. (1962). Individual ability as a determinant of group superiority. *Human Relations, 15*, 45-51.

Tuckman, B. (1965) Developmental Sequence in Small Groups. *Psychological Bulletin*, *63* (6), 384 – 399.

Tuckman, B.W.& Jensen, M.C. (1977). Stages of Small Group Development Revisited. *Group and Organization Studies, 2* (4), 419-426

Verduin, J. R. & Clark, T. A. (1991*). Distance education: The foundations of effective*

practice. San Francisco, CA: Jossey-Bass.

Watson, G.B. (1928). Do groups think more effectively than individuals? *Journal of Abnormal and Social Psychology, 23*, 328-336.

Will, A.M. (1997). Group learning in Workshops. *New Directions for Adult and Continuing Education, 76*, 33-40.

Yaverbaum, G.J. and R.J. Ocker. (1998) "Problem Solving in the Virtual Classroom: A Study of Student Perceptions Related to Collaborative Learning Techniques", Working paper, School of Business Administration, Pennsylvania State University at Harrisburg.

Zajonc, R.B. (1965). The requirements and design of a standard group task. *Journal of Experimental Social Psychology, 1*, 71-88.

APPENDIX A

Student Profiles

Student Profiles

Student Code	Age	Learning Style Preferences
T1-S1	28	Active/Reflective Visual Sensing/Intuitive Sequential
T1-S2	30s	Active Visual Sensing/Intuitive Sequential
T1-S3	25	Active Visual Sensing Sequential/Global
T1-S4	40s-50s	Active Visual Sensing Sequential
T2-S1	24	Active/Reflective Visual Sensing/Intuitive Sequential
T2-S2	51	Active/Reflective Visual Sensing Sequential
T2-S3	25	Reflective Visual/Verbal Intuitive Sequential/Global
T3-S1	24	Active Verbal Sensing Global
T3-S2	20s	Active Visual Intuitive Sequential
T3-S3	50s	Reflective Visual/Verbal Intuitive Sequential/Global
T3-S4	30s	Active Visual Sensing

		Sequential/Global
T4-S1	27	Active Visual/Verbal Sensing/Intuitive Sequential/Global
T4-S2	50s	Active/Reflective Visual Sensing Sequential/Global
T4-S3	20s	Active/Reflective Visual Sensing/Intuitive Sequential/Global
T4-S4	20s	Active/Reflective Visual/Verbal Sensing/Intuitive Sequential

APPENDIX B

Index of Learning Styles Questionnaire

Index of Learning Styles Questionnaire

Barbara A. Soloman
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Richard M. Felder
Department of Chemical Engineering
North Carolina State University
Raleigh, NC 27695-7905

Directions

Please provide us with your full name. Your name will be printed on the information that is returned to you.

Full Name

For each of the 44 questions below select either "a" or "b" to indicate your answer. Please choose only one answer for each question. If both "a" and "b" seem to apply to you, choose the one that applies more frequently. When you are finished selecting answers to each question please select the submit button at the end of the form.

1. I understand something better after I
   - **(a)** try it out.
   - **(b)** think it through.
2. I would rather be considered
   - **(a)** realistic.
   - **(b)** innovative.
3. When I think about what I did yesterday, I am most likely to get
   - **(a)** a picture.
   - **(b)** words.
4. I tend to
   - **(a)** understand details of a subject but may be fuzzy about its overall structure.
   - **(b)** understand the overall structure but may be fuzzy about details.

5. When I am learning something new, it helps me to
   - ☐ **(a)** talk about it.
   - ☐ **(b)** think about it.
6. If I were a teacher, I would rather teach a course
   - ☐ **(a)** that deals with facts and real life situations.
   - ☐ **(b)** that deals with ideas and theories.
7. I prefer to get new information in
   - ☐ **(a)** pictures, diagrams, graphs, or maps.
   - ☐ **(b)** written directions or verbal information.
8. Once I understand
   - ☐ **(a)** all the parts, I understand the whole thing.
   - ☐ **(b)** the whole thing, I see how the parts fit.
9. In a study group working on difficult material, I am more likely to
   - ☐ **(a)** jump in and contribute ideas.
   - ☐ **(b)** sit back and listen.
10. I find it easier
    - ☐ **(a)** to learn facts.
    - ☐ **(b)** to learn concepts.
11. In a book with lots of pictures and charts, I am likely to
    - ☐ **(a)** look over the pictures and charts carefully.
    - ☐ **(b)** focus on the written text.
12. When I solve math problems
    - ☐ **(a)** I usually work my way to the solutions one step at a time.
    - ☐ **(b)** I often just see the solutions but then have to struggle to figure out the steps to get to them.
13. In classes I have taken
    - ☐ **(a)** I have usually gotten to know many of the students.
    - ☐ **(b)** I have rarely gotten to know many of the students.

14. In reading nonfiction, I prefer

- **(a)** something that teaches me new facts or tells me how to do something.
- **(b)** something that gives me new ideas to think about.

15. I like teachers

- **(a)** who put a lot of diagrams on the board.
- **(b)** who spend a lot of time explaining.

16. When I'm analyzing a story or a novel

- **(a)** I think of the incidents and try to put them together to figure out the themes.
- **(b)** I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.

17. When I start a homework problem, I am more likely to

- **(a)** start working on the solution immediately.
- **(b)** try to fully understand the problem first.

18. I prefer the idea of

- **(a)** certainty.
- **(b)** theory.

19. I remember best

- **(a)** what I see.
- **(b)** what I hear.

20. It is more important to me that an instructor

- **(a)** lay out the material in clear sequential steps.
- **(b)** give me an overall picture and relate the material to other subjects.

21. I prefer to study

- **(a)** in a study group.
- **(b)** alone.

22. I am more likely to be considered

- **(a)** careful about the details of my work.
- **(b)** creative about how to do my work.

23. When I get directions to a new place, I prefer
    - ☐ **(a)** a map.
    - ☐ **(b)** written instructions.

24. I learn
    - ☐ **(a)** at a fairly regular pace. If I study hard, I'll "get it."
    - ☐ **(b)** in fits and starts. I'll be totally confused and then suddenly it all "clicks."

25. I would rather first
    - ☐ **(a)** try things out.
    - ☐ **(b)** think about how I'm going to do it.

26. When I am reading for enjoyment, I like writers to
    - ☐ **(a)** clearly say what they mean.
    - ☐ **(b)** say things in creative, interesting ways.

27. When I see a diagram or sketch in class, I am most likely to remember
    - ☐ **(a)** the picture.
    - ☐ **(b)** what the instructor said about it.

28. When considering a body of information, I am more likely to
    - ☐ **(a)** focus on details and miss the big picture.
    - ☐ **(b)** try to understand the big picture before getting into the details.

29. I more easily remember
    - ☐ **(a)** something I have done.
    - ☐ **(b)** something I have thought a lot about.

30. When I have to perform a task, I prefer to
    - ☐ **(a)** master one way of doing it.
    - ☐ **(b)** come up with new ways of doing it.

31. When someone is showing me data, I prefer
    - ☐ **(a)** charts or graphs.
    - ☐ **(b)** text summarizing the results.

32. When writing a paper, I am more likely to
    - ☐ **(a)** work on (think about or write) the beginning of the paper and progress forward.
    - ☐ **(b)** work on (think about or write) different parts of the paper and then order them.

33. When I have to work on a group project, I first want to

- ☐ **(a)** have "group brainstorming" where everyone contributes ideas.
- ☐ **(b)** brainstorm individually and then come together as a group to compare ideas.

34. I consider it higher praise to call someone

- ☐ **(a)** sensible.
- ☐ **(b)** imaginative.

35. When I meet people at a party, I am more likely to remember

- ☐ **(a)** what they looked like.
- ☐ **(b)** what they said about themselves.

36. When I am learning a new subject, I prefer to

- ☐ **(a)** stay focused on that subject, learning as much about it as I can.
- ☐ **(b)** try to make connections between that subject and related subjects.

37. I am more likely to be considered

- ☐ **(a)** outgoing.
- ☐ **(b)** reserved.

38. I prefer courses that emphasize

- ☐ **(a)** concrete material (facts, data).
- ☐ **(b)** abstract material (concepts, theories).

39. For entertainment, I would rather

- ☐ **(a)** watch television.
- ☐ **(b)** read a book.

40. Some teachers start their lectures with an outline of what they will cover. Such outlines are

- ☐ **(a)** somewhat helpful to me.
- ☐ **(b)** very helpful to me.

41. The idea of doing homework in groups, with one grade for the entire group,

- ☐ **(a)** appeals to me.
- ☐ **(b)** does not appeal to me.

42. When I am doing long calculations,
    - ☐ **(a)** I tend to repeat all my steps and check my work carefully.
    - ☐ **(b)** I find checking my work tiresome and have to force myself to do it.

43. I tend to picture places I have been
    - ☐ **(a)** easily and fairly accurately.
    - ☐ **(b)** with difficulty and without much detail.

44. When solving problems in a group, I would be more likely to
    - ☐ **(a)** think of the steps in the solution process.
    - ☐ **(b)** think of possible consequences or applications of the solution in a wide range of areas.

When you have completed filling out the above form please click on the Submit button below. Your results will be returned to you. If you are not satisfied with your answers above please click on Reset to clear the form.

APPENDIX C

Learning Styles and Strategies

LEARNING STYLES AND STRATEGIES

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ACTIVE AND REFLECTIVE LEARNERS

- Active learners tend to retain and understand information best by doing something active with it--discussing or applying it or explaining it to others. Reflective learners prefer to think about it quietly first.
- "Let's try it out and see how it works" is an active learner's phrase; "Let's think it through first" is the reflective learner's response.
- Active learners tend to like group work more than reflective learners, who prefer working alone.
- Sitting through lectures without getting to do anything physical but take notes is hard for both learning types, but particularly hard for active learners.

Everybody is active sometimes and reflective sometimes. Your preference for one category or the other may be strong, moderate, or mild. A balance of the two is desirable. If you always act before reflecting you can jump into things prematurely and get into trouble, while if you spend too much time reflecting you may never get anything done.

How can active learners help themselves?

If you are an active learner in a class that allows little or no class time for discussion or problem-solving activities, you should try to compensate for these lacks when you study. Study in a group in which the members take turns explaining different topics to each other. Work with others to guess what you will be asked on the next test and figure out how you will answer. You will always retain information better if you find ways to do something with it.

How can reflective learners help themselves?

If you are a reflective learner in a class that allows little or no class time for thinking about new information, you should try to compensate for this lack when you study. Don't simply read or memorize the material; stop periodically to review what you have read and to think of possible questions or applications. You might find it helpful to write short summaries of readings or class notes in your own words. Doing so may take extra time but will enable you to retain the material more effectively.

SENSING AND INTUITIVE LEARNERS

- Sensing learners tend to like learning facts, intuitive learners often prefer discovering possibilities and relationships.
- Sensors often like solving problems by well-established methods and dislike complications and surprises; intuitors like innovation and dislike repetition. Sensors are more likely than intuitors to resent being tested on material that has not been explicitly covered in class.
- Sensors tend to be patient with details and good at memorizing facts and doing hands-on (laboratory) work; intuitors may be better at grasping new concepts and are often more comfortable than sensors with abstractions and mathematical formulations.
- Sensors tend to be more practical and careful than intuitors; intuitors tend to work faster and to be more innovative than sensors.
- Sensors don't like courses that have no apparent connection to the real world; intuitors don't like "plug-and-chug" courses that involve a lot of memorization and routine calculations.

Everybody is sensing sometimes and intuitive sometimes. Your preference for one or the other may be strong, moderate, or mild. To be effective as a learner and problem solver, you need to be able to function both ways. If you overemphasize intuition, you may miss important details or make careless mistakes in calculations or hands-on work; if you overemphasize sensing, you may rely too much on memorization and familiar methods and not concentrate enough on understanding and innovative thinking.

How can sensing learners help themselves?

Sensors remember and understand information best if they can see how it connects to the real world. If you are in a class where most of the material is abstract and theoretical, you may have difficulty. Ask your instructor for specific examples of concepts and procedures, and find out how the concepts apply in practice. If the teacher does not provide enough specifics, try to find some in your course text or other references or by brainstorming with friends or classmates.

How can intuitive learners help themselves?

Many college lecture classes are aimed at intuitors. However, if you are an intuitor and you happen to be in a class that deals primarily with memorization and rote substitution in formulas, you may have trouble with boredom. Ask your instructor for interpretations or theories that link the facts, or try to find the connections yourself. You may also be prone to careless mistakes on test because you are impatient with details and don't like repetition (as in checking your completed solutions). Take time to read the entire question before you start answering and be sure to check your results

VISUAL AND VERBAL LEARNERS

Visual learners remember best what they see--pictures, diagrams, flow charts, time lines, films, and demonstrations. Verbal learners get more out of words--written and spoken explanations. Everyone learns more when information is presented both visually and verbally.

In most college classes very little visual information is presented: students mainly listen to lectures and read material written on chalkboards and in textbooks and handouts. Unfortunately, most people are visual learners, which means that most students do not get nearly as much as they would if more visual presentation were used in class. Good learners are capable of processing information presented either visually or verbally.

How can visual learners help themselves?

If you are a visual learner, try to find diagrams, sketches, schematics, photographs, flow charts, or any other visual representation of course material that is predominantly verbal. Ask your instructor, consult reference books, and see if any videotapes or CD-ROM displays of the course material are available. Prepare a concept map by listing key points, enclosing them in boxes or circles, and drawing lines with arrows between concepts to show connections. Color-code your notes with a highlighter so that everything relating to one topic is the same color.

How can verbal learners help themselves?

Write summaries or outlines of course material in your own words. Working in groups can be particularly effective: you gain understanding of material by hearing classmates' explanations and you learn even more when you do the explaining.

SEQUENTIAL AND GLOBAL LEARNERS

- Sequential learners tend to gain understanding in linear steps, with each step following logically from the previous one. Global learners tend to learn in large jumps, absorbing material almost randomly without seeing connections, and then suddenly "getting it."
- Sequential learners tend to follow logical stepwise paths in finding solutions; global learners may be able to solve complex problems quickly or put things together in novel ways once they have grasped the big picture, but they may have difficulty explaining how they did it.

Many people who read this description may conclude incorrectly that they are global, since everyone has experienced bewilderment followed by a sudden flash of understanding. What makes you global or not is what happens before the light bulb goes on. Sequential learners may not fully understand the material but they can nevertheless do something with it (like solve the homework problems or pass the test) since the pieces they have absorbed are logically connected. Strongly global learners who lack good sequential thinking abilities, on the other hand, may have serious difficulties until they have the big picture. Even after they have it, they may be fuzzy about the details of the subject, while sequential learners may know a lot about

specific aspects of a subject but may have trouble relating them to different aspects of the same subject or to different subjects.

How can sequential learners help themselves?

Most college courses are taught in a sequential manner. However, if you are a sequential learner and you have an instructor who jumps around from topic to topic or skips steps, you may have difficulty following and remembering. Ask the instructor to fill in the skipped steps, or fill them in yourself by consulting references. When you are studying, take the time to outline the lecture material for yourself in logical order. In the long run doing so will save you time. You might also try to strengthen your global thinking skills by relating each new topic you study to things you already know. The more you can do so, the deeper your understanding of the topic is likely to be.

How can global learners help themselves?

If you are a global learner, just recognizing that you aren't slow or stupid but simply function differently from most of your classmates can help a great deal.[4] However, there are some steps you can take that may help you get the big picture more quickly. Before you begin to study the first section of a chapter in a text, skim through the entire chapter to get an overview. Doing so may be time-consuming initially but it may save you from going over and over individual parts later. Instead of spending a short time on every subject every night, you might find it more productive to immerse yourself in individual subjects for large blocks. Try to relate the subject to things you already know, either by asking the instructor to help you see connections or by consulting references. Above all, don't lose faith in yourself; you will eventually understand the new material, and once you do your understanding of how it connects to other topics and disciplines may enable you to apply it in ways that most sequential thinkers would never dream of.

APPENDIX D

Coding Scheme

Coding Scheme based on Bruce Tuckman's Stages of Group Development

Category	Major Processes	Characteristics
Forming	Development of attraction bonds; exchange of information; orientation towards others and situation	F1 Orientation through testing; tentative, polite towards others F2 Identifying boundaries of interpersonal and task behaviors; business conducted F3 Unsure; insecurity, silences overcome by establishing dependency relationships with leader and members F4 Exchange of information
Storming	Dissatisfaction with others; competition among members	S1 Conflict and polarization over interpersonal issues; intra-group conflict; disagreement over procedures S2 Resistance to group influence and task requirements S3 Negativity threatens development; ideas criticized; hostility S4 Emotions evident; patience breaks; emotional response to task demands S5 Technological obstacles to task completion S6 Confusion on task requirements, roles, or procedures S7 Conflict suppressed
Norming	Development of group structure; increased cohesiveness and harmony; establishment of roles and relationships	N1 Agreement on rules; consensus-seeking; increased supportiveness; "we" feeling; agree with conditions N2 Resistance overcome N3 Personal opinions expressed in task realm; personal information shared N4 Understand each other; listen and appreciate; sensitivity N5 Eliciting or offering alternative views and methods for standards related to task completion N6 Seeks or responds for clarification or confirmation of procedures N7 Open exchange of relevant interpretations
Performing	Focus on achievement; high task orientation; emphasis on performance and productivity	P1 Group identity high; roles flexible and functional; look to leader; leader offers guidance P2 Without conflict, energy is high and channeled into task; decreased emotions P3 Structural issues resolved; functional role relatedness P4 High task orientation; emergence of solutions P5 Offering or eliciting alternative solutions for task completion P6 Offering or eliciting feedback (positive or negative) P7 Reflection, explanation, justification, clarification of task role or task completion P8 New member may revert to storming
Adjourning	Termination of duties; reduction of dependency; task completion	A1 Task completion A2 Regret; increased emotions A3 disengagement