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THE EFFECTS OF GROUP DYNAMICS ON PERCEIVED INDIVIDUAL
LEARNING IN PARTIALLY DISTRIBUTED TEAMS

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Abstract

With advances in technology, teams are no longer restricted by distance and time barriers. A partially distributed team (PDT) can be defined as a team with two subteams. Each subteam consists of multiple collocated members. However, any two subteams are geographically distant from one another. As PDTs are increasingly prevalent in organizations, it is important to prepare students to collaborate in a PDT context. This thesis explores how PDT team dynamics impact student learning. Over 700 students from 15 universities collaborated in PDTs during a five-week project. Students completed training on PDT collaboration and worked to design an emergency management information system (EMIS). Students completed weekly surveys and reflections throughout the project, which were used to quantitatively and qualitatively analyze the impact of team dynamics on student learning. Overall, positive team interactions resulted in higher learning levels in terms of both PDT collaboration and EMIS knowledge.

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Chapter 1: Introduction

Organizations and educational environments have been relying heavily on technology to conduct work and communicate across distances. Due to technology breaking down borders and shortening distances, partially distributed teams have become more popular. A distributed team is a group of people that work together with a common goal across time, space, and organizational boundaries (Mazneviski and Chudoba, 2000). A partially distributed team (PDT) can consist of two or more subteams, each located in a different area (Ocker et al., 2009). A partially distributed team (PDT) can be defined as a team with two subteams. Each subteam consists of multiple collocated members. However, any two subteams are geographically distant from one another. Each PDT member, as well as his/her context, influences the group in different ways through group interaction.

In order to grasp the importance of interaction within all groups, Theorist Kurt Lewin created the term group dynamics (Lewin, 1951). Group dynamics is the area of study that examines how people work in small groups (Lewin, 1951). Although group dynamics was originally created to deal with groups that were collocated (i.e., located in one place), the term can be expanded to fit distributed teams due to their interdependent goals. Group dynamics is the study of the group as a whole unit; how group members' combined personalities, moods, and emotions work together. Individual success or failure is not measured; it is studied to determine how that success or failure affected the outcome of the entire group.

PDTs are an increasingly prevalent configuration of teams in organizations. Thus, it is important to educate and train students how to work effectively in this context. This thesis attempts to shed light on PDT effectiveness with regard to student learning through the lens of group dynamics. Although it is important that a PDT succeeds, it is vital that each individual student is able to learn from the experience so they are better prepared for future challenges they may face. This thesis seeks to find the connection between group dynamics and individual learning in PDTs by summarizing current research on group dynamics, learning, and PDTs, as well as quantitative and qualitative research conducted using surveys completed by university students involved in a project using PDTs.

Chapter 2: Group Interaction

A group, in general, is three or more people who interact with one another. Each individual is influenced by and influences other individuals in the group. The key word within the definition is *influence*. Members that are in the same group influence each other in various ways, creating change. Overall, groups are not static; they tend to develop throughout their lifecycle (Moorhead and Griffin, 2001). As they develop, the members of the team interact. There is a fundamental assumption that input factors, including individual, group, and environmental factors, affect performance outcomes, such as task quality, through the interaction process (Hackman and Morris, 1975).

Previously, due to the uniqueness of each team, scientists knew little about how they functioned and interacted. Theorist Kurt Lewin created the term group dynamics in 1940 to signify the importance of a group as a whole unit (Lewin, 1951). Within the psychology and social sciences fields, this term quickly became a large area of study that examines how people work in small groups; it has since then expanded into the fields of management researchers and applied social scientists.

Group dynamics provides information that can be used to help understand and improve the operations of teams (Levi, 2001). It is the ability of individuals to work together (Harris and Sherblom, 2002). More specifically, group dynamics is defined as the combined personality, moods, and emotions of the group members. Ultimately, group dynamics leads to the success or failure of a group. The dynamics of a group depend on many different factors, including the amount of conflict, coordination, efficacy, trust, common ground, and shared identity that exists among members within the group (Murphy and McIntyre, 2007).

2.1 Group Dynamics

Conflict in groups is impossible to avoid due to the complexity and interdependence of each member (Jehn, 1995). However, it can be beneficial if the group is able to grow from their differences (Crowe and Hill, 2006). Conflict can arise from many different sources, including poor group norms, hidden agendas, and personality differences. There are two types of conflict that a group can encounter, task and relational. Task conflict arises from different opinions about the task on which the group is working. It is the awareness of difference in viewpoints and opinions regarding the group's work (Jehn and Mannix, 2001). Relational conflict arises from competition over power, confusion over communication, and individual problems (Levi, 2001). It is the awareness of interpersonal incompatibilities. Teams with some level of task related conflict have more animated discussions, often leading to the exploration of more approaches and ideas (Jehn and Mannix, 2001). However, groups with relationship conflict tend to be less efficient due to negative stress and emotions (Murphy and McIntyre, 2007). This type of conflict can also interfere with communication and the completion of the task.

Another key factor of group dynamics is coordination, which is a cognitive form of organization. There are two different forms of coordination that can occur in groups, the administrative coordination of routine tasks and the management of knowledge and skills (Faraj and Sproull,

2000). The management of knowledge and skills is highly important when dealing with complex, interdependent tasks. It is the coordination of members prior work expertise in a way that makes their knowledge accessible to the entire team (Hoch, Pearce, and Welzel, 2010). However, both forms of coordination positively affect team performance (Ancona and Caldwell, 1992). In order to enhance coordination in teams, especially in distributed teams, it is helpful to establish norms and standardized practices (Ramesh and Dennis 2002).

A third key factor of group dynamics is group efficacy, which happens at both the individual and group levels. At the individual level, group efficacy is a member's "assessment of the group's ability to perform task-related behaviors" (Dolen, Ruyter, and Carmen, 2005). At the group level, group efficacy is the entire group's belief in its ability to perform task-related actions. This belief in the group's ability is not merely general confidence; efficacy is extremely task specific (Gibson, 1999). Bandura (1986) suggests that the strength of groups lies in the member's sense of group efficacy that they can solve the task at hand. At both levels, high efficacy leads to more task-focused behaviors within the group (Dolen, Ruyter, and Carmen, 2005). Although efficacy is beneficial, it has been shown that when efficacy is high during the beginning stages of group development, task conflict is lower. This makes groups less effective at the task they are trying to complete due to an undiversified thought process (Goncalo, Polman, and Maslach, 2010).

A fourth key factor of group dynamics is trust. When present, group trust is beneficial to group interaction. Overall, trust justifies an individual's decision to cooperate within the group (Liu, Magjuka, and Lee, 2008). Trust can enhance collaboration and increase production because group members do not feel the need to watch over one another. Individuals feel comfortable, lowering their expectations of being exploited or used (Tanghe, Wisse, and Flier, 2010). Also, groups with high levels of trust can be more creative in their problem solving techniques (Liu, Magjuka, and Lee, 2008).   When trust is not present in a group, members tend to work defensively. This impedes the flow of information, ideas, and communication, ultimately hurting the group. In some instances, lack of trust can even lead to the demise of a group (Liu, Magjuka, and Lee, 2008).

The fifth key factor of group dynamics is common ground. When members join a group, they maintain their own beliefs and assumptions. Clark describes this as their common ground, or the group member's mutual knowledge, beliefs, and suppositions (Clark, Schreuder, and Buttrick, 1983, 1978). Each group member makes his or her own assumptions about shared ideas during group interaction (Clark and Schaefer, 1989). Depending on whether or not the group members' assumptions match up, a shared team identity can occur.

A sixth key factor of group dynamics is shared team identity, which is explained through social identity theory. This theory suggests that people gain their social identity through group membership (Tajfel, 1978). Differences in opinions and viewpoints results in individuals categorizing themselves into two distinct groups, the "ingroup" and the "outgroup" (Ocker et al., 2009; Tajfel, 1974). Separate identities are developed between the two subgroups, creating ingroup dynamics. This is defined as increase interaction and preferential behavior toward the members of one's own subgroup (Ocker et al., 2009). It has been noted that the perception of two groups within one will lead to decreased satisfaction, reduced coordination, communication, and cooperation, and higher levels of relationship conflict (William and O'Reilly, 1998).

2.2 Group Development

In order for a group to grow and refine their group dynamics, they must develop. There are various models of group development that suggest how groups mature over time. These models include Tuckman's stage model (1965), which indicates that groups go through different stages in order to complete their task. Gersick (1988) and Wheelan (1994) suggest more complex theories; however these theories still consider the backbone of Tuckman's stage model (Miller, 2003). In recent years, theorists have added and removed different stages to the model due to new research done in the area of teaming (Tuckman and Jensen, 2010). As more research is completed, group development models become more refined.

Tuckman's stage model (see Figure 1) suggests that groups go through different stages in order to complete their task. According to this sequential model, a group cannot move onto the next stage without completing the previous stage. Each of the stages contributes to the dynamics of the group. The first stage is forming, which involves the group members physically becoming one group. During this stage, the members share their expectations about the project. They also start exchanging personal information, such as their likes and dislikes. While mutually accepting each other, group members can also discuss unimportant issues, such as the weather and sports (Moorhead and Griffin, 2001). In the second stage of norming, the group members begin working on the project where they try to meet each other's expectations on quality of work. Trust is either lost or gained in this stage. Communication and decision-making are key during norming. The group members start to share their opinions openly, which can result in the creation of group norms (Moorhead and Griffin, 2001). The third stage is storming, which occurs when there is conflict within the group. The conflict can arise in many different ways, and depending on the severity, can affect how long the storming stage lasts. The final stage is performing, which occurs when the group completes the storming stage and is able to move past the conflict. Aspects of control and organization usually occur in order for the group to reach its goal (Moorhead and Griffin, 2001). In order for this to be achieved, roles become more flexible and functional (Tuckman, 1965). This stage is different for all groups. If the group has positive group dynamics, the performing stage is empowering. If they group has negative group dynamics, the performing stage is difficult and threatening to the completion of the task (Crowe and Hill, 2006).

Forming	Storming	Norming	Performing

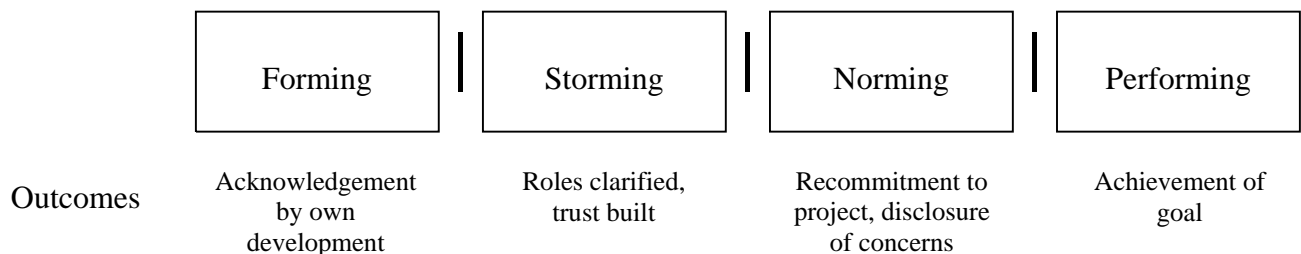|	Forming	Storming	Norming	Performing
Outcomes	Acknowledgement by own development	Roles clarified, trust built	Recommitment to project, disclosure of concerns	Achievement of goal

Figure 1 Tuckman's Stage Model (adapted from Fritz, Boren, and Egger, 2005)

Gersick (1988) elaborated and refined Tuckman's stage model to create a new hybrid group development model, Punctuated-Equilibrium Model (PEM) (see figure 2). In PEM, a group develops through three stages in order to accomplish its goal. As groups progress through each stage, their task performance increases as their time for completion decreases (Hurt and Trombley, 2007). As its name suggests, Gersick's model is based on the evolutionary theory of punctuated-equilibrium, where groups experience periods of inertia and intense periods of quantum change (Gersick, 1988).

In the first stage, groups are created. The individuals are relaxed and not concerned about the future project deadline. The general direction of the project is discussed and some goals are created. In the second stage, usually around the halfway point of the project, the group has a high level of activity (Hurt and Trombley, 2007). In this transition phase, group stressors are introduced, along with general problems being addressed. The changes that occur in the second stage are attributed to the group member's awareness of time and deadline (Gersick, 1989). In the third and final stage, the group begins to streamline their original plan. They refine their goals and process, which produces higher levels of performance and increased energy. Most work is completed in this third stage (Hurt and Trombley, 2007).
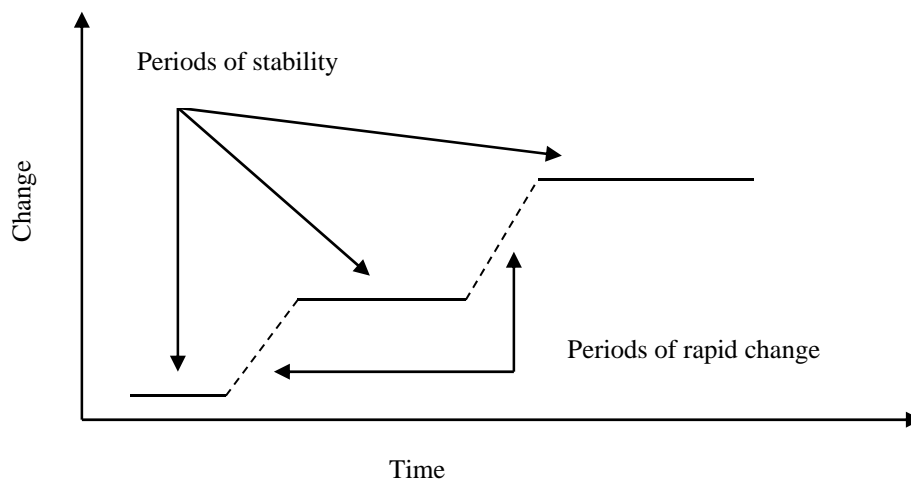
Figure 2 PEM (adapted from Carpenter, Bauer, and Erdogan, 2009)

Due to the vast amount of research in the area of group development, Wheelan integrated the models from the last several decades into a single model. The Integrative model suggests that groups go through five different stages that are based on patterns of behavior (Wheelan, 1994). The first stage of group development is based on the behaviors of dependency and inclusion. Members are nervous about the new situation, often becoming polite and cautious when exchanging ideas. The leader of the group is the focus, as the members are very dependent (Wheelan and Kesselring, 2005). The second stage is based on the behaviors of counter-dependency and fight. In this stage, team members begin to express their feelings, creating disagreements and conflict. Members try to differentiate themselves by creating roles and finding their independence. Dependent on how long the conflict lasts, the group moves onto stage three, which focuses on the behaviors of trust and structure. The unavoidable conflict in

stage two creates bonds and group coordination within the group. Communication becomes more open and group roles are reestablished. Due to these changes, group productivity increases (Wheelan, 1994). The fourth behavioral pattern is work. Although work has been ongoing since the group formation, it is at its highest level of productivity after the third stage. The group moved passed their individual differences and can now focus all of its energy on the task at hand (Wheelan and Kesselring, 2005). Wheelan argues that groups should have some amount of time awareness while they work, if they are working effectively.   The fifth and final stage focuses on termination behavior. This is the group's ending point where they evaluate their competed work and the other individuals in the group (Chang, Artemis, and Duck, 2003).

Chapter 3: Learning

Learning is important; as a person learns, they increase their capacity to take effective action (Klein, 1998). Learning can be divided into two parts; it is the acquirement of skill, implying the physical ability to produce some action, and the acquirement of know-why, which is the ability to articulate and understand an experience (Klein, 1998). When structured in an educational environment, learning is the two-step process of reception, which is gaining internal and external information, and processing (Richard and Silverman, 1988). Because a student has the ability to block out external information, they are able to absorb certain things and ignore others.

Due to every student's unique way of gaining information, many theories have been developed to describe how learning occurs. Behaviorism explains learning as a behavioral response to physical stimuli (Fosnot and Perry, 2005). The students are seen as passive; often needing motivation and are highly affected by reinforcement (Skinner, 1953). Another respected theory is Maturationism. In Maturationism, learning is dependant on the developmental stage of the student (Fosnot and Perry, 2005). Students are able to interpret experiences based on their level of maturity. A third theory is constructivist learning, which is opposite of both Behaviorism and Maturationism (Fosnot and Perry, 2005). Constructivism focuses on cognitive development and deep understanding as a complex and nonlinear process. Theorist Paiget (1950), the creator of constructivism, defines learning as the mutual interaction of accommodation and assimilation. The main idea is that knowledge is constructed, emergent, and grounded in action and experience (Jonassen, Peck, and Wilson, 1999). In order for the student to learn, they must be inventive and have self-organization strategies. Also, social interaction with knowledgeable members of a community or group is important in advancing ideas and understanding (Pritchard and Woollard, 2010). Learning in the constructivist theory is not a result of development; learning is development (Fosnot and Perry, 2005).

3.1 Group Learning

As the constructivist theory suggests, dialogue within a community or group stimulates further thinking. The student becomes responsible for defending and justifying his/her ideas to the rest of the group (Fosnot and Perry, 2005). As a result, working in groups promotes elaboration, justification and argumentation, which promote learning (Yadin, and Or-Bach, 2010). However, without the proper environment, these triggers may not lead to learning. In order to create an environment of knowledge building, all group members must take the responsibility of advancing the collective understanding of the group (Bereiter, 2002). Groups do this by creating a learning strategy. There are a variety of strategies that a group can incorporate.

Self-directed learning places the responsibility of learning on the individual; the student learns at his or her own pace and determines his or her own level of expertise (Hatcher, 1997). Although this can be successful, self-directed learning depends greatly on the individual's own initiative and planning (Hashim, 2008). Another learning strategy involves a competitive environment. In a competitive strategy, students are placed against each other fighting for results (Anderson, 2006). Learning is sometimes over-shadowed because students have a short-term perspective focused on winning or losing (Johnson and Johnson, 1989).

In order to create open dialogue and foster deep understanding, a group should incorporate a cooperative learning strategy. In a cooperative learning strategy, students work together in a supportive way. The task must be intellectually demanding and open ended, forcing students to think creatively (Ross and Smyth, 1995). In this strategy, students have more positive attitudes towards the subject matter, other students, and social support (Nagel, 2008). This type of environment also improves students' self-esteem and communication (Nagel, 2008). Furthermore, some research indicates that students learn significantly more in a cooperative environment than those working alone; reasoning levels increase, as well as generation of new ideas and solutions (Johnson and Johnson, 1989).

Despite having a cooperative learning environment, a group may experience setbacks and learning deficiencies from free riders. Free riders are students who benefit from a collaborative environment, but do not contribute to the common goal or learning of the group (Morrison, 2004). Free riders are a significant barrier to group learning because of their unwillingness to participate (Barker, Garvin-Doxas, and Jackson, 2002; Joyce, 1999). In order to be successful, students must show high motivation and involvement in their group (Hansford and Wylie, 2002). When students do not show an interest in learning, a cooperative environment will not have enough participants to succeed.

3.2 Individual Learning

Successful collaboration that leads to learning starts with individual abilities and responsibilities (Yadin, and Or-Bach, 2010). As a result, group learning is directly and indirectly affected by individual learning (Klein, 1998). Group learning is independent of a specific member, but it cannot be independent of all members (Klein, 1998). Therefore, individual learning is key for the group to succeed.

Through much research, self-efficacy is shown as the most effective predictor of a student's learning (Yadin, and Or-Bach, 2010). Self-efficacy is a person's perception of his or her own knowledge, capabilities, and ability to perform a specific task (Bandura, 1993). It measures performance capabilities, not physical characteristics (Yadin, and Or-Bach, 2010). Self-efficacy is essential for learning because it will influence efforts more than actual ability (Cavaco, Chettiar, and Bates, 2003). Studies have confirmed that students with positive self-efficacy are even more likely to continue on with difficult tasks (Linnenbrink and Pintrich, 2002). Although a student may not know what the next step is, they will try out different solutions to find the correct one. This process allows the student to grow and learn. On the other hand, students with negative self-efficacy will give up when a task becomes difficult, stopping the learning process (Zimmermann, 2000). It is also noted that when a student is set up to succeed, there is more opportunity to learn. While working on a challenging, but feasible, task, students strengthen their skills and develop new capabilities (Glynn, Aultman, and Owens, 2005).

Chapter 4: Partially Distributed Teams

A partially distributed team (PDT) can be defined as two or more subteams, each located in a different area, working together on a common task across time, space, and organizational boundaries (Mazneviski and Chudoba, 2000; Ocker et al., 2009). Each subteam consists of multiple collocated members. However, any two subteams are geographically distant from one another. This formation of different subgroups within the same group can be explained through the fault line hypothesis. Originally proposed by Lau and Murninhan (1998), the theory states that a single group can be divided into multiple homogeneous subgroups based on a set of attributes. The attributes that pertain to PDTs are psychological (Hart and Van Vugt, 2006). Since a PDT is made up of multiple subgroups distributed across space and often time, collocated members within a given subgroup have their own beliefs, values and culture, which are different from another subgroup. Thus, a natural separation between subgroups occurs. This separation creates dividing lines, called fault lines (Lau and Murninhan, 1998). Although fault lines can go unnoticed for long periods of time, added pressure and conflict within the group can make them prevalent (Hart and Van Vugt, 2006). Depending on the strength of the fault line, it can either have a small or large impact on the PDT.

If the fault lines within a group are strong enough, they can cause a PDT to be cognitively split depending on their location. This in-group/out-group phenomenon causes a creation of a group within the main group (Burke and Aytes, 2002). Described more simply, members of the same group treat each other as if they were part of a different group (Armstrong and Cole, 2002). Many times these subgroups develop their own identity, exhibiting preferential treatment toward their own local group (Ocker, Rosson, Kracaw, and Hiltz, 2009). When this happens, local team members rely on each other when faced with problems and blame each others' mistakes on the situation (Sole and Edmondosn, 2002; Cramton, 2002). However, they find that distant team members are less helpful and blame their failures only on them, not considering any external factors (Herbsleb, Mockus, Finhott and Grinter 2000; Cramton, 2002). Although this phenomenon can be detrimental to learning and collaboration, groups can overcome their separation through participation and communication.

Usually, communication and participation is done through electronic mediums, such as email and text chat with little to no face-to-face communication. This makes continual communication difficult and often results in a fragmented transfer ideas and messages between subgroups (Armstrong and Cole, 2002). This lack of communication within the group can have an effect on work relations. Subgroups start acting as satellites to each other, causing problems due to group configuration (Grinter, Herbsleb, and Perry, 1999). Spontaneous conversations, such as chatting in the hall and informal meetings, include members from only one subgroup. This can result in distant subgroup members feeling cut off and rejected (Armstrong and Cole, 2002). Feedback from distant locations can be easily misunderstood and taken out of context. Also, distances block casual visual observations that lead to informal learning (Armstrong and Cole, 2002). Many times a subgroup can be completely forgotten. This out of sight, out of mind situation can result in growing tensions between locations (Armstrong and Cole, 2002). These problems cause subgroups to disproportionately place their attention on their local subgroup instead of equally between the subgroups (Fiol and O'Connor, 2005).

4.1 Keys to success in Partially Distributed Teams

In order for a PDT to be successful, the team needs to develop collaboration know-how. Know-how is defined as the knowledge to transfer inputs into outputs as effectively as possible (Brown and Duguid, 1998). This task is action oriented and developed on an individual level (Brown and Duguid, 1998). An individual must know how to communicate his or her own ideas and integrate them with their group member's ideas (Majchrzak, Malhotra, and John, 2005). This blending of ideas will help build a collaborative work environment, despite the distance between group members.

Another factor in successful PDT's is having a strong shared identity. A shared group identity represents a member's sense of belonging within the group (Ashforth and Mael, 1989). Having a shared identity has been shown to create a more trusting atmosphere. Group members become more loyal towards each other and are concerned about promoting the welfare of the group (Brewer and Miller, 1996). Individual members have higher confidence and personal satisfaction (Fiol and O'Connor, 2002). Also, shared identity has the ability to reduce conflict between members (Jehn et al., 1999). However, when a shared identity is not present, other group member's actions are seen a negative way and a competitive relationship can form (Hinds and Mortensen, 2005).

4.2 Barriers to success in Partially Distributed Teams

PDTs are prone to several barriers that pertain to group dynamics. One barrier to success that groups face is the idea of social loafing. A group member that exhibits social loafing behavior provides less than maximum participation due to lack of motivation and different circumstances (Kidwell and Bennett, 1993). This phenomenon can affect the group's interaction, including individual and collective outcomes. Social loafing can increase if a group member feels that their contribution has a marginal effect on the team's success (Chidambaram and Lai, 2005). Although this phenomenon is focused on traditional groups, it is expected that PDT's experience a similar situation and are affected in the same way. As group members become more isolated, their participation and contributions to the group decrease (Williams et al., 1981). Social loafing can increase when group member's perceptual aspects, such as difficulty identifying members in a distant subgroup, grow (Chidambaram and Lai, 2005).

Another barrier that PDT's struggle with is conflict. Distributed teams not only find conflict common in the group, but it is hard to isolate and manage (Hinds and Bailey, 2003). Members that are collocated tend to have trouble with different perspectives, unshared information, and growing tensions (Armstrong and Cole, 2002). Conflict increases due to weak interpersonal relationships and poor information sharing techniques (Hinds and Bailey, 2003). However, conflict can be reduced with development of a shared identity, as mentioned above.

Chapter 5: Research Question

The overall question for this research is "How do group dynamics affect individual student learning in partially distributed teams?" In order to do address this question, factors that encompass group dynamics are analyzed to determine if, and to what extent, they affect an individual's perceived learning. Analysis methods incorporate a combination of quantitative and qualitative data, as discussed in the Methods section.

Chapter 6: Methods

6.1 Subjects
There were 713 students who participated in the Fall 2009 study. Students came from 15 universities across 8 different counties. The universities were located in Germany, Ireland, Lithuania, Mexico, Singapore, Spain, Switzerland, and the USA. Each PDT consisted of two subteams, with an average of 5 collocated members within each subteam. On a given team, each subteam was from a different country and at least one subteam was from the USA. There were a total of 80 teams in the study.

6.2 Task
Each team had the requirement of formulating the high-level information requirements for an Emergency Management Information System (EMIS) called Bioterrorism Management and Planning System (BTMAPS) for Chile. The students created a final report over five weeks that responded to a Request for Proposal (RFP). The students also completed intermediate tasks during each week. The five weeks of the project were divided into teaming activities and BTMAPS task-related activities. Teams completed team-building activities during weeks one, two and three and BTMAPS activities during weeks two through five.

6.3 Team collaboration support
Every team was given a private collaboration space on Moodle, a free and open source course management system, which provided a file sharing repository, threaded discussion board, and a project calendar. The teams were not required to use this system, but were encouraged to use it.

6.4 Procedures
During week one, the students were assigned three tasks. The first was a one-paragraph self-introduction post to the team forum. This allowed both distant and local team members to get to know one another. The second was the creation of two scenarios that had to be completed by both subteams. The scenarios focused on problems that PDTs encountered and suggested solutions to prevent them. The third task was the completion of a team contract from a provided template. Both subteams created a team contract separately then collaboratively combined them into one final team document.

During week two, the students held one on one interviews with a member of their distant subteam. Each team member then wrote up their interviewee's answers and posted the paragraph on their team's webpage.   In addition to the interviews, each subteam completed the Stakeholder Analysis Part I assignment, which identified ten BTMAPS stakeholders. Subteams then collaboratively combined their stakeholders into one team list.

During week three, each subteam evaluated their distant subteam's performance with the 3 Bin Assessment. After sharing their assessment with their distant subteam, the team created an action plan. This plan focused on fixing the identified negative areas of their team performance. Teams also completed the Stakeholder Analysis Part II assignment where they created a list of output screens their previously identified stakeholders would use. Using their list, the teams then created graphical user interface mock-ups of the output screens.

During week four, the teams completed the Stakeholder Analysis Part III assignment. The teams created a list and graphical user interface mock-ups of input screens to be used for identified stakeholders to enter information into BTMAPS.

During week five, the teams revised their Stakeholder Analysis Parts I to III and completed a final proposal. The final proposal was a significant percentage of the student's course grade, providing motivation to be successful in creating the EMIS.

6.5 Data Collection
For extra credit, participants completed a background survey, weekly and post-project survey, and weekly personal reflections, which were open-ended questions.

Chapter 7: Measures

Scale items (see Tables 1 - 7) for constructs pertaining to group dynamics and learning within a subteam and between subteams were included in the post-project survey. The conflict and shared identity constructs were measured by scale items adapted from Mortensen and Hinds (2001). Group efficacy was measured by scale items adapted from Lent, Schmidt, and Schmidt (2006). Coordination was measured by scale items adapted from Faraj and Sambamurthy (2006). The trust construct was measures by two scales: process trust and personal trust. The process trust scale items were adapted from Jarvenpaa et al. (1998) and the personal trust questions were adapted from Cummings and Bromily (1996). Finally, the distance learning and critical thinking scale items were adapted from Hiltz (1988, 1994) and Alavi (1994).

Survey items were measured using a seven-point response scale. For the critical thinking learning scale, response scales were anchored with disagree (1) and agree (7). For conflict, personal trust, process trust, shared identity, critical thinking learning, and distance skills learning, the scale anchors were strongly disagree (1) and strongly agree (7). For group efficacy, the scale anchors were one for no confidence and seven for complete confidence. For coordination, the scale anchors were one for to a small extent and seven for to a great extent. Tables 1 through 7 contain the scale-item questions that were used to measure each construct.

Table 1. Conflict scale items

1	Much disagreement existed in my subteam / between subteams.
2	There was a great deal of personality conflicts in my subteam / between subteams.
3	A great deal of disagreement regarding project work existed in my subteam / between subteams.

Table 2. Group efficacy scale items

	Based on your experience with this project, rate your confidence in your subteams / teams capabilities in accomplishing the following
1	Communicating well with one another even though we are from different universities
2	Working well together even in challenging situations.
3	Finding ways to capitalize on the strengths of each member

Table 3. Coordination scale items

	To coordinate member effort within my subteam / between subteams, there were
1	Procedures for coordinating work
2	Project milestones and delivery schedules
3	Project documents and memos
4	Regularly scheduled team meeting (face to face and/or electronic)

Table 4. Trust scale items

1	I was comfortable when other members worked on a critical task or problem in my subteam / distant subteam.
2	Even if I could not monitor them, I was comfortable giving a critical task or problem to other members in my subteam / distant subteam.
3	I felt that members kept their word in my subteam / distant subteam.
4	I felt that members were honest with me in my subteam / distant subteam.
5	I felt that members negotiated joint expectations fairly in my subteam / distant subteam.
6	I felt confident that members would not exploit me in my subteam / distant subteam.
7	I would have preferred if some members had less influence over important aspects of the project in my subteam / distant subteam.
8	I wanted to more closely monitor the work of members in my subteam / distant subteam.
9	I felt the members tried to get out of their commitments in my subteam / distant subteam.
10	I felt that members tried to get the upper hand in my subteam / distant subteam.

Table 5. Shared identity scale items

1	I feel loyal towards my subteam / my team.
2	I see myself as a member of my subteam / my team.
3	I am proud to think of myself as a member of my subteam / my team.

Table 6. Critical Thinking Learning scale items

	Working on the PDT project
1	Increased my ability to integrate facts from multiple sources.
2	Increased my ability to consider different requirements and design options.
3	Increased my confidence in expressing ideas.
4	Reinforced the importance of other points of view.

Table 7. Distance Skills Learning Scales

	Working on the PDT project
1	Increased my skills at working in a distributed team.
2	Increased my ability to team with others across distance.
3	Provided me with a real-world perspective on distributed teams.
4	Gave me a good hands-on experience at collaborating across distance.

Scale Reliability

For each group dynamics and learning scales, a reliability test, Cronbach's alpha, was conducted and scale statistics were determined before the variable could be used for further analysis. Since

each group dynamics scale was used to measure *within* a subteam and *between* subteam dynamics, reliability was tested for both of these cases for each scale. *Within* a subteam represents the interaction of only the local team. *Between* subteams represents interactions between the two collocated subteams that comprised a given team. Between subteams is also referred to as team interaction. All variables need a Cronbach's alpha of .7 or above in order to be considered reliable. All scales had an alpha of .7 or above except for trust.

The original scale for trust was unreliable, with Cronbach's alpha below .5. A factor analysis was conducted on the ten trust scale items. Similar to prior related research (Plotnick, Hiltz, and Ocker, 2011), this resulted in two factors which were labeled *personal trust* and *process trust*. Scale items for each trust scale are shown below (see tables 8 to 9). Personal trust is based on members' interactions and process trust is based on members' inferences made about other group members (Plotnick, Hiltz, and Ocker, 2011). The reliability analysis for process trust between subteams resulted in a Cronbach's Alpha of just slightly below .7 (.698), so it is considered acceptable.

Table 8. Personal Trust Scale Items

1	I was comfortable when other members worked on a critical task or problem in my subteam / distant subteam.
2	Even if I could not monitor them, I was comfortable giving a critical task or problem to other members in my subteam / distant subteam.
3	I felt that members kept their word in my subteam / distant subteam.
4	I felt that members were honest with me in my subteam / distant subteam.
5	I felt that members negotiated joint expectations fairly in my subteam / distant subteam.
6	I felt confident that members would not exploit me in my subteam / distant subteam.

Table 9. Process Trust Scale Items

1	I would have preferred if some members had less influence over important aspects of the project in my subteam / distant subteam.
2	I wanted to more closely monitor the work of members in my subteam / distant subteam.
3	I felt the members tried to get out of their commitments in my subteam / distant subteam.
4	I felt that members tried to get the upper hand in my subteam / distant subteam.

The results of the reliability tests and scale statistics (see tables 10 to 25) are shown below for both the within and between subteam scales.

Table 10. Conflict Reliability Statistics

	Cronbach's Alpha	N of items
Within Subteam	.808	2
Between Subteam	.828	3

Table 11. Conflict Scale Statistics

	Mean	Variance	Std. Deviation
Within Subteam	1.8356	1.396	1.18174
Between Subteam	2.0840	1.22914	1.22914

Table 12. Group Efficacy Reliability Statistics

	Cronbach's Alpha	N of items
Within Subteam	.900	2
Between Subteam	.912	3

Table 13. Group Efficacy Scale Statistics

	Mean	Variance	Std. Deviation
Within Subteam	5.8140	1.586	1.25942
Between Subteam	5.2395	2.152	1.46691

Table 14. Coordination Reliability Statistics

	Cronbach's Alpha	N of items
Within Subteam	.821	4
Between Subteam	.873	4

Table 15. Coordination Scale Statistics

	Mean	Variance	Std. Deviation
Within Subteam	5.2038	1.547	1.24372
Between Subteam	4.6709	2.294	1.51445

Table 16. Personal Trust Reliability Statistics

	Cronbach's Alpha	N of items
Within Subteam	.886	6
Between Subteam	.912	6

Table 17. Personal Trust Scale Statistics

	Mean	Variance	Std. Deviation
Within Subteam	5.6604	1.616	1.27120
Between Subteam	5.1129	2.355	1.53449

Table 18. Process Trust Reliability Statistics

	Cronbach's Alpha	N of items
Within Subteam	.742	4
Between Subteam	.698	4

Table 19. Process Trust Scale Statistics

	Mean	Variance	Std. Deviation
Within Subteam	2.4695	1.808	1.34452
Between Subteam	2.7283	1.806	1.34405

Table 20. Shared Identity Reliability Statistics

	Cronbach's Alpha	N of items
Within Subteam	.927	3
Between Subteam	.940	3

Table 21. Shared Identity Scale Statistics

	Mean	Variance	Std. Deviation
Within Subteam	5.9757	1.674	1.29365
Between Subteam	5.2572	2.736	1.65416

Table 22. Critical Thinking Learning Reliability Statistics

	Cronbach's Alpha	N of items
Individual	.952	4

Table 23. Critical Thinking Learning Scale Statistics

	Mean	Variance	Std. Deviation
Individual	4.6095	2.312	1.52066

Table 24. Distance Learning Reliability Statistics

	Cronbach's Alpha	N of items
Individual	.951	4

Table 25. Distance Learning Scale Statistics

	Mean	Variance	Std. Deviation
Individual	5.2991	2.330	1.52652

Chapter 8: Results

8.1 Regression Analysis

Using the scale variables, two regression analyses were conducted to investigate the relationship between group dynamics and learning. The independent variables for both learning scales (critical thinking and distance skills) tests were the aspects of group dynamics for within the subteam and between subteams, including conflict, group efficacy, coordination, personal trust, process trust, and shared identity. The dependent variable for the first regression analysis was learning critical thinking skills while the dependent variable for the second regression analysis was learning to work across distances. Results of the regression analyses are shown in tables 26 and 27.

Table 26. Regression Analysis for Critical Thinking Learning

	B	Std. Error	Beta	t	Sig.
Conflict Within	.040	.069	.031	.575	.566
Conflict Between	.126	.068	.102	1.858	.064
Group Efficacy Within	-.092	.084	-.077	-1.096	.273
Group Efficacy Between	**.227**	**.077**	**.218**	**2.948**	**.003**
Coordination Within	**.304**	**.066**	**.248**	**4.618**	**.000**
Coordination Between	**.213**	**.057**	**.212**	**3.757**	**.000**
Personal Trust Within	.109	.086	.091	1.257	.209
Personal Trust Between	-.093	.079	-.094	-1.176	.240
Process Trust Within	**.214**	**.082**	**.189**	**2.600**	**.010**
Process Trust Between	-.127	.086	-.112	-1.477	.140
Shared Identity Within	**.198**	**.081**	**.169**	**2.451**	**.015**
Shared Identity Between	.008	.062	.009	.132	.895

Table 27. Regression Analysis for Distance Skills Learning

	B	Std. Error	Beta	t	Sig.
Conflict Within	.074	.065	.057	1.146	.252
Conflict Between	.112	.063	.090	1.758	.079
Group Efficacy Within	.055	.079	.045	.695	.487
Group Efficacy Between	**.177**	**.072**	**.171**	**2.467**	**.014**
Coordination Within	.117	.061	.096	1.906	.057
Coordination Between	**.281**	**.053**	**.279**	**5.289**	**.000**
Personal Trust Within	.026	.081	.022	.325	.746
Personal Trust Between	.074	.074	.075	1.003	.316
Process Trust Within	.022	.077	.019	.287	.775
Process Trust Between	-.049	.080	-.043	-.606	.545
Shared Identity Within	.123	.076	.105	1.629	.104
Shared Identity Between	.087	.058	.095	1.516	.130

The analysis of the critical thinking regression of learning revealed that coordination within subteams and between subteams, team efficacy, subteam shared identity, and subteam process trust within subteams were statistically significant. The analysis of the distance skills learning regression revealed that coordination between subteams and team efficacy between subteams were statistically significant.

In summary, each of the five factors of group dynamics was represented by a separate scale. For each scale, a reliability test was run to determine if that scale could be used in the analysis. Trust was divided into personal trust and process trust, based on a factor analysis. Two aspects of learning were measured: critical thinking learning and distance skills leaning for more precise analysis. Each scale had an acceptable level of reliability. Two regression analyses were run to determine the relationship between group dynamics and learning.

8.2 Journal Entry Analysis

In an attempt to contextualize the findings of the quantitative analysis, a qualitative analysis of team member weekly reflections was conducted for a subset of teams (There were 80 teams in total). Contrasts are most clearly identified by comparing the most divergent cases (Eisenhard, 1989), thus high-learning and low-learning teams were selected for the qualitative analysis. To select teams, an analysis of variance by groups was run in order to identify high learning teams and low learning teams. The fixed factor was the team number and the dependent variables were critical thinking skills and distance skills learning. For each dependent variable, the means for the 80 teams were calculated and sorted from low to high. From both high and low teams, fifteen teams were chosen for further review from the critical thinking and distance skills learning data set. A set of five teams, 11, 33, 56, 75, and 80, were identified as being high critical thinking learning and a similar set of five teams, 33, 54, 56, 80, and 77, were identified as being high distance skills learning. However, the same five teams were identified as being low learners in both areas.

High Critical Thinking Learning Teams

The journal entries of five teams that reported high levels of critical thinking learning were analyzed. Each team reported similar practices and opinions, including doing most of the work within their own subteam. However, the reasons for this shared work structure varied. They also reported high levels of coordination within their subteam.

Task division

Throughout the five weeks, each high critical thinking team divided the tasks between the respective subteams and completed them within their subteams. This resulted in reduced communication problems between subteams and made tasks more manageable, as evidenced by the following journal entries.

> *"Things were easy to manage within our local subteam. We were able to divide up tasks and make sure our part of the assignment got done." (Team 11, UWash, week 4)*

"This week we had no problems because we have distributed the work" (Team 56, UC3M, week 3)

This type of work strategy was especially helpful for Team 80 when the tasks became more complicated during week 3.

"The deliverables this week have seemed to require more personal attention than previous weeks. In other words, we have spent a lot more time involved on working on individual assignments rather than collaborative work with the subteams or the team as a whole." (Team 80, GCSU, week 3)

Other teams were forced to separate the tasks because communication between subteams had failed.

"Communication between subteams was not very good. Tasks were done properly by separating tasks into members. Social communication within my subteam was improved in this week." (Team 75, UWash, week 4)

Time was also a determinate when dividing up the tasks. Some teams did not have enough time to properly complete the task all together, forcing them to separate the assignment.

"We have created a good team through especially team activities. We simply do not have enough time to discuss issues deeply between both subteams." (Team 75, UWash, week 3)

"This week was very busy so we just shared what to do, mostly we worked in our groups." (Team 11, Lithuania, week 5)

Coordination

Due to the initial planning and communication that must be completed to divide up tasks between subteams, the teams learned how to coordinate effectively with each other. As the project continued, the teams settled into a routine.

"Team Dynamics have been excellent. We have settled into a routine mode of workflow. Problems have been addressed properly, and there are no frustrations so far. Things are going well." (Team 80, NUS, week 3)

"In this week,[we] found that the team co-ordination was very good. The work has been completed with less communication and better understanding. Everybody worked actively to achieve the goal." (Team 80, NUS, week 5)

"Great team communication. Team leaders are coordinating well with the subteam members, and we are getting everything done on time." (Team 33, PSU, week 3)

Shared Identity

Although work was completed at the subteam level, two of the teams were able to create a shared identity during the beginning weeks of the project through their coordination practices.

> *"So far my experience with my team has been good. I've worked with members of my subteam before. The distance subteam has a lot of commonalities with my local one." (Team 80, GCSU, week 1)*

> *"When it started was a little difficult to communicate each other, i felt i were working with two teams my local and the pdt team but now i think i'm working only with one tema." (Team 33, ITSEM, week 2)*

Trust

This shared identity helped lead to the formation of trust within the second and third weeks. This trust helped build satisfaction and comfort levels between the subteams.

> *"Trust has surprising come very easy to us all. The distant team has been forthcoming and diligent in their submissions and maintain a friendly demeanor which helps me feel comfortable in trusting them." (Team 80, GCSU, week 2)*

> *"...team have good trust in each other and it was pleasant to work with my team mates. Even though there are some miss communication in the process I am satisfied with the result." (Team 11, UWash, week 3)*

Team Efficacy

Near the end of the project, teams with high levels of trust exhibited group efficacy. In Team 75, this group efficacy led to complete trust and confidence in their entire team.

> *"During the fifth week of pdt, the trust between the two subgroups solidified. We knew that each of us did our fair share of work and were able to collaborate accordingly to make a strong final proposal." (Team 75, PSU, week 5)*

In summary, five teams with high critical thinking learning were chosen and their weekly journals were qualitatively analyzed. Two different work patterns emerged from the teams. Some teams worked by completing most of the work within their own subteam. Due to poor communication, work was divided and done at the subteam level. In other teams, collaboration levels remained high throughout the project. Many of the teams also developed a feeling of shared identity or team efficacy, which helped them build trust between subteams. This trust led to confidence in the group. It is apparent that these teams all had positive group dynamics. They found a way to work together that improved the quality of their tasks. By coordinating effectively and working closely within their subteam, they were able to enhance their critical thinking skills.

High Distance Learning Teams

The journal entries of five teams that reported high levels of distance skills learning were analyzed. Each team exhibited many of the same traits throughout the five weeks, including high levels of communication and the formation of trust. Through these two aspects, the teams were able to coordinate together and create a shared identity. Each of these aspects is discussed further below.

Communication

During the five weeks, each of the high distance learning teams had consistent levels of communication. In each team, subteam members had concerns about the project in the beginning weeks, but the active communication during the first weeks of the project helped lower their anxiety and create a routine.

> *"There is great awareness of what is expected and our subteam leaders will help reach our goals as a team" (Team 77, GCSU, week 1)*

> *"I think we are starting to communicate and find the best way to work together" (Team 33, ITESM, week 1)*

As the project progressed, the amount of communication increased between subteams. This increase helped each team work through their problems easier, reducing the amount of relationship conflict and increasing coordination.

> *"We are improving the communication and each week is better for all, the stuff is made right without conflicts and we have better coordination" (Team 54, UC3M, week 4)*

> *"Our group worked extremely well together again. We communicated and solved all problems efficiently." (Team 77, GCSU, week 4)*

By the end of the project, communication became routine. Teams were communicating within and between subteams effectively, helping produce high levels of positive team dynamics.

Trust

As well as constant communication, each of the high learning teams developed a feeling of trust throughout the project. During the initial weeks of the project, trust was still forming and developing between subteams. However, trust was established out of a hard work ethic and team coordination in week three.

> *"There is very good rapport and trust among the teams now. The feeling of togetherness has considerably increased and quickly we are able to churn out with the deliverables." (Team 77, NUS, week 3)*

"There is overall a high level of trust between my sub teams. Every member of the group contributes and performs solid work." (Team 33, PSU, week 3)

By the end of the project, each team continued to have high levels of trust. As described in the following quote, one team trusted their distant subteam with review and submission of the entire team's work.

"This week my subteam did some of the work first and then sent it to our team in Madrid to look over it, complete it, and submit it." (Team 56, PSU, week 5)

In another example, one member feels trusting enough in their team's ability to take on more complicated tasks. This type of team confidence can develop strong group efficacy.

"Once again, things are going good. We seem to trust each other a little bit more with the work. I think that our team could produce some pretty complicated tasks if we were given the task." (Team 33, PSU, week 5)

Shared Identity

As communication and trust increased during the project, teams were able to develop a team identity. By working together, the teams created common ground and were thus able to guard against ingroup/outgroup bias.

"There is nice coordination and everyone share a sense of responsibility." (Team 77, NUS, week 3)

"With the established team structure and leadership roles, we feel as one team where joint deliverables are required." (Team 80, NUS, week 4)

In one example, two members of the team were unable to complete their work due to illness. Despite the set back, both subteams worked together to make up for the missed work without blaming the members for their absence.

"This time around, 2 distance team members were seriously ill. But, it didn't get in our way of getting work done. Things went smooth. Everyone knew what they were doing." (Team 54, PSU, week 4)

In summary, the weekly journals entries of the five highest distance learning teams were qualitatively analyzed. The teams encompassed many of the same traits. Trust was developed, as well a team unity. The teams either reported feeling shared identity and/or group efficacy emerging throughout the five weeks. It is apparent that these teams all had positive group dynamics. They worked well together; conflict was task related and they maintained regular communication. They were able to learn how to work across distances through their positive interactions with their distant subteam.

Low Learning Teams

The journal entries of five teams with the lowest perceived learning of both critical thinking and distance skills were read and analyzed. The two aspects of learning were combined because of the extreme similarity between the two sets of teams. Also, each identified team reported the same problems and issues leading to their downfall. Therefore low critical thinking skills and low distance learning were analyzed together. The most prominent problems in each team were a lack of motivation and team confusion. These issues stem from communication problems, low team identity, and team dissatisfaction. Each of these aspects is discussed below.

Differences in Motivation

During the project, motivation on both subteams was a big factor in thinking critically and learning how to work across distances. Most of the teams with low reported learning had certain members unmotivated or unwilling to do the work. In team 35, one subteam expressed how each of their members were interested in receiving a good grade.

> *"There's not much of a sense of us being a single team but our subteam is better as we are all interested in receiving a good grade." (Team 35, UWash, week 2)*

However, the subteam from University of Washington was impeded from learning due to their distant subteam, who thought they were taking the project too seriously.

> *"the team is working good, i still think that our foreign subteam is taking it too seriusly, i'm not saying is a bad thing but fro us is not that important, that's why we are performing just enough to get through this commitment." (Team 35, ITSEM, week 2)*

Team 27 had similar problems. The lack of motivation for the project was discussed throughout the five weeks by members of both subteams. Only part of one subteam was participating in the project.

> *"There seems to be only one person from the other group who is working and communicating" (Team 27, PSU, week 3)*

> *"problems, concerns, and frustrations : our local team members never came to class, and so it is hard to stay motivated if you are 2 guys doing the work for a whole group" (Team 27, Salle, week 5)*

A team member from Team 41 expressed similar disappointment in his/her own subteam's motivation.

> *"The other team works very well and it's a pleasure to work with them. Unfortunately I don't have the feeling that a subteam exists, because half of the team doesn't do anything, even don't send any message, which is frustrating." (Team 41, ITESM, week 2)*

Differences in Perception

As well as lack of motivation among some subteam members, differences in team perception were significant contributors to low levels of learning. In many teams, the two subteams reported different levels of satisfaction and conflicting information. For example, in Team 18, both subteams reported that the other subteam stopped communicating and did not want to do any work. They also both reported that their subteam tried to contact the other.

> *"Our distant subteam refused to work with us."(Team 18, Lithuania, week 5)*

> *"There was trouble with our distant subteam. They stopped communicating with us even when we sent them messages." (Team 18, UWW, week 5)*

In another example, Team 13 reported two different opinions regarding team satisfaction. One subteam reported that everything was going well while the other reported communication errors and frustration.

> *"Both teams working together without conflicts, all work was dynamic and there was a sense of being a single team." (Team 13, Lithuania, week 5)*

> *"This week was frustrating as our team checked out the progress of our current grades. Due to communication errors (or lack of), we found that several documents were either not turned in or submitted incorrectly." (Team 13, PSU, week 5)*

Communication

Although differences in motivation and differences in perception were large contributors to low reported learning, communication problems and team dissatisfaction were also problems. In most low learning teams, communication became nonexistent by the end of the project.

> *"Communication between the two subteams is pretty nonexistent. Within my subteam, the core focus is now on just completing the assignment." (Team 35, UWash, week 5)*

In one example, the PSU subteam from Team 41 expressed lack of participation and no communication from their distant subteam.

> *"In the 5th week things kind of reverted back to that of week one. The team from Monterrey didn't respond to any of our emails and didn't really have any participation within the project." (Team 41, PSU, week 5)*

This statement was further confirmed to be true by the only distant subteam member response.

> *"No changes" (Team 41, ITESM, week 5)*

In summary, five teams with the lowest overall learning were chosen and their journal entries were analyzed. All of the teams had some communication problems during the five weeks. This

led to a lack of coordination in most teams resulting in conflicted feelings about team unity and satisfaction being reported. It is clear that these teams shared no identity and team trust was low. Also in most teams, there was a lack of motivation on the part of one subteam. This resulted in an unbalanced workload and major team dissatisfaction. These factors, unmotivated members and low coordination, resulted in negative group dynamics. The teams hardly interacted, leaving little area for trust building and the establishment of a shared identity.

Chapter 9: Discussion

The results of the regression analysis and qualitative analysis of journal entries of high- and low-learning teams indicate that group dynamics have an affect on the perceived learning of individual team members. Both learning constructs -- critical thinking and distance skills -- were affected by factors of group dynamics. However, team interaction varied with respect to between subteam and within subteam learning. In general, the data revealed that critical thinking skills were used and developed within subteams, while distance skills were learned through between subteam interaction. In low learning situations, teams experienced negative group dynamics, especially in terms of coordination and team identity. It is noteworthy that the lowest scoring teams were identical across both aspects of learning, indicating that these teams experienced serious impediments that transcended the different types of learning.

Both learning constructs are discussed further below.

9.1 Critical thinking learning for high teams

Within subteams
Critical thinking skills were enhanced through interaction on the local level within a subteam, suggesting that most of the individual's critical thinking skills were used and developed within their own subteam. This is shown specifically through the significance of subteam coordination, shared identity and process trust variables from the regression analysis as well as examination of individual's journal entries. Subteam coordination was identified, indicating that high learning collocated subteams were operating smoothly and effectively, enhancing positive attitudes toward the collocated subteam. Process trust was also identified as significant, indicating that the inferences made about other subteam members were positive. This trust could have helped the subteams become more creative in dividing up the tasks and solving problems, as well as developing group norms. A third variable identified was shared identity. This indicates that the subteam felt connected, sharing the same beliefs and assumptions.

Between subteams
Although the majority of critical thinking was enhanced at a subteam level, some between subteam variables had an impact. These variables were identified through both the regression analysis and examination of the individual's journal entries. Group efficacy between subteams was identified as a significant factor, indicating that the group had confidence they could accomplish task related actions. This confidence helped to enhance critical thinking because it is extremely task specific. Team coordination was also identified, indicating that not only the subteams were operating effectively, but the entire team was as well. This furthered the positive feelings an individual possessed regarding the entire group. These two variables helped cultivate a cooperative learning strategy in the group, which has been shown to increase reasoning levels as well as generation of new ideas and solutions (Johnson and Johnson, 1989).

Group efficacy and team coordination developed throughout the five weeks of the project through team interactions. Two distinct patterns of development emerged from the qualitative analyzed. The first pattern was a divide-and-conquer approach exhibited by teams 11, 56, and

75. Communication levels started and remained low. As tasks became more complex, work was divided between the subteams and there was little interaction between subteams. However, the teams developed a feeling of efficacy by the last week, which is shown through their confidence in each member's ability to complete the assignment. The second pattern emphasized collaboration and was exhibited by teams 80 and 33. These teams started with high levels of trust in the beginning weeks. Communication and coordination levels remained high throughout the project, which led to the formation of routines. Trust continued to develop, as well as a shared identity, which is shown through the full support members gave to their distant subteam.

9.2 Distance skills learning for high teams

Through the results of the regression analysis, between subteams variables were identified as being significant. This indicates that skills that aided in working across distances were learned through between subteam/entire team interaction, as expected. Students learned how to manage work and relationships across distances when interacting with their distant subteam. Group efficacy was one variable identified as significant, indicating that the team had confidence in itself. Although efficacy is extremely task related, the communication and coordination that was necessary to complete the task forced the team to work across distances. Coordination was also identified, indicating that the team was working effectively, resulting in a supportive atmosphere. This support system that was developed helped relationships across distances mature, creating a cooperative learning environment.

Examination of individual's journal entries confirmed that skills related to distance were gained through team interaction. Team coordination was identified through open communication between subteams as well as positive feelings expressed about the group. As stated above, this coordination allowed the team to develop a supportive atmosphere and cooperative learning environment. Another aspect of group dynamics that was identified at the team level was a shared identity. This indicates that the team felt connected. By identifying themselves as one team, the individuals bridged the distance gap between them. A third aspect that was developed through the team's shared identity was trust, both personal and process. This trust indicated the team was comfortable. Each member knew that they would not be exploited or used, helping them focus on creating connections and completing the task. This behavior indicated the group was in the third stage of Gersick's PEM. Their performance levels increased with refined goals and a streamlined plan (Hurt and Trombley, 2007).

Each of these variables contributing to high distance skills learning was developed throughout the five weeks of the project through group interactions and dynamics.   One distinct pattern of development emerged from the teams that were qualitatively analyzed. The groups started off with good communication in the beginning weeks. Common ground was established by weeks 3 and 4; however, trust took longer to develop. As communication continued throughout the project, the bond between subteams grew. Trust was fully established by the end of the project, which is shown through the comfort of the members and the confidence they had in their team.

9.3 Critical thinking and distance skills learning for low teams

Analogous to the results above, examination of low learning individuals' journal entries indicated that teams with low interaction had trouble thinking critically and learning across distances. Each of the issues identified negatively impacted the formation of a cooperative learning environment, cutting off open dialogue and the potential to gain a deep understanding. One issue identified was a lack of coordination present between subteams. This created much confusion between the subteams, hurting the group's success. Most of the individuals had only negative feeling toward their groups. Another issue that results from this confusion was low team identity. Indicated through a lack of unity, the individuals felt that they were divided, resulting in two distinct groups – an "ingroup" and an "outgroup". Near the end of the project, most subteams did not associate with their distant subteam in any way. A third issue was a lack of group efficacy, indicting low confidence in the group's abilities. This was expressed through dissatisfaction with other members and little motivation to complete the task, resulting in feelings that the group would not be able to complete the project.

Each of these variables contributing to low critical thinking and distance skills learning were seen throughout the five weeks of the project through poor group interactions and negative dynamics. One distinct pattern of development emerged from the teams that were qualitatively analyzed. Communication levels started off low, contributing to low team unity in the beginning weeks of the project. In addition to low team unity, low motivation levels continued from the start of the project to the finish. This lack of unity and low participation led to misperceptions and miscommunications throughout the five weeks.

Chapter 10: Recommendations

There are many factors that contribute to critical thinking in PDTs but the most influential factors are subteam coordination and trust. High levels of trust were important in order for subteam members to feel comfortable sharing their ideas. This type of atmosphere reduced groupthink, which produced more animated discussions about the task. In order to cultivate a more cohesive, trusting atmosphere within subteams, it is important to have open and honest communication within the first week of the project. By discussing potential problems and fears, subteam members will grow closer. This can be accomplished through brainstorming sessions or open group meetings. Common ground will eventually grow out of the trust each member has for one another.

Unlike critical thinking, distance skills were learned through team interactions (i.e., between subteams). In order to learn how to work across distances, constant team communication is an important factor. Teams that had continuous communication were able to learn from experience the difficulties and benefits of working with a distant subteam. In order to continue communication throughout the five weeks of the project, all team members have to stay motivated. In instances where team members lost interest and became unmotivated, team communication suffered. This greatly impacted the way the team worked, causing most teams to cut off distance communication completely. Another factor affecting communication is team confidence. When teams were confident in themselves and each other, attitudes were positive and communication remained task focused. This helped relationships across distances mature.

In order to combat the issues and achieve the relationships stated above, there are various things that can be incorporated into the PDT project for students, instructors, and project creators. Below are some recommendations for each group:

Students have the greatest amount of control over their group dynamics, interactions, and deliverables so it is important that the team is unified and working together. One change the students can make in the project to increase unity and provide a greater chance at success is to keep communication constant. This will potentially create a shared identity and help keep group members motivated. Another change the students can make is establishing a team plan in the contract that is made in week one. This can include how the meetings will be held, who will lead the meetings, and how work will be coordinated between the subteams. It can also state how the group will interact, through the entire team or just through the team leaders. These factors are important to decide at the beginning of the project in order to keep relationship conflict low and coordination high.

Teachers are an important part of the project, providing guidance to the students and keeping them motivated to work. One change the teachers can make on the project to keep students interested is weighting the project grade more heavily. If the overall project is worth more toward the student's class grade, each student will have more motivation is succeed. This may help team interaction, as well as increase both constructs of learning. Another change the teachers can make is implementing negative consequences for non-participating group members. These negative consequences can include lowering their grade for every day of non-

participation, removal from the group and forced to complete the project alone, or getting a zero on deliverables they did not contribute work towards. Implementing these consequences may improve project participation.

Project creators determine what activities the students will be participating in as well as implementing guidelines for students and teachers to follow.   One change in the project that may increase between subteam interactions is the requirement of the deliverables to be created with the entire team.   Currently, most of the deliverables are to be created within the subteams then combined before submission. An example of this is in week two with the Stakeholder Analysis Part I.   The teams are told to complete the analysis within their own subteams, and then combine the two documents into one as a team. If the subteams were forced to create the document together, from start to finish, they will be more exposed to working across distances and critical thinking between subteams may flourish. This change could help increase both constructs of learning in the PDT project.

Chapter 11: Limitations

All studies have certain limitations. One issue in this study is that the teams were made up of only two subteams. In reality most PDTs are made up of multiple collocated subteams, creating a more complex group. Also, the project had a definitive start and end time of only five weeks. The timeline may not be as well defined in PDTs created for corporate projects.

Another limitation was identified while collecting data. Learning occurred at an individual level, however team results were used to determine which factors were significant and which journal entries to read. This technique that identifies high learning teams may have left out individual high learners on teams that rated low on the learning scale. However, those outliers that reported high levels of learning on low learning teams may not be reliable sources. This lessens the concern to identify those outliers for the purpose of this study.

Chapter 12: Conclusion

The interactions within a subteam and between subteams had an affect on how each individual member learned. As each team moved through their own model of development, their group dynamics were refined. Critical thinking skills were enhanced through subteam interaction, with an emphasis on subteam coordination and trust. These factors helped to create a supportive atmosphere cultivating a cooperative learning strategy. Creative thinking was able to flourish, as well as open dialogue and a deep understanding. Distance skills were gained through entire team interaction with an emphasis on coordination and group efficacy. These factors contributed to team communication and trust. However, teams were unable to learn critically and how to work across distances with unmotivated members. Their unwillingness to participate proved to be a significant barrier to learning. The five factors of group dynamics each play an important role in team interactions and success. By keeping team interaction positive, PDT members have a higher chance at learning and enhancing their skill set.

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