

# How Group Dynamics Affect Team Achievements in Virtual Environments

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## ABSTRACT

*This study explored the elements that affect team achievements in virtual environments. In this study, consideration was given to the role of group dynamics in facilitating productive interaction. We aspired to reveal the mechanisms of group dynamics and examined how group dynamics affected team achievements in virtual environments. The empirical study was performed with undergraduate students enrolled in an e-learning course. In collaboration with other majors, students executed team projects and managed project issues in forums or chat rooms. The results of the empirical study indicated that leadership, creative friction, and group cohesion (components of group dynamics) had positive relationships with team achievements. The findings confirmed that addressing creative conflict is a method to improve team performance and that leadership is a key factor in project teams.*

**Keywords:** Group Dynamic, Projects Team, Team Achievements, Virtual Environments.

## 1. INTRODUCTION

Recently, companies have been faced with fierce competition and organizations are forced to adapt quickly or cease to exist in this sort of business environment. In order to meet the demands of rapid change, most companies build flexible and temporary groups such as project teams or virtual teams. Project teams and virtual teams have the same fundamental purpose, whether collocated or dispersed. They use the power of collective intelligence to troubleshoot and solve a problem. Project member's participation and retention depends on member attachment, which is cultivated by connecting members with topics of interest to them and like-minded others. According to Matzat [29], successful interaction in online communities depends on both high usability and efforts that support the members' social interaction as a group. To promote effective group interaction, reinforcing team spirits and group interactions is necessary. In this study, consideration was given to the role of group dynamics as a tool to facilitate productive interaction in a virtual environment. Group dynamics are a kind of mechanism for group interaction. They accommodate different viewpoints and keep project members focused on specific tasks. Group dynamics are not well researched, but they are important for collaboration and

creativity leading to joint knowledge creation and troubleshooting. This study assumed that group dynamics promoted effective interaction in groups and attempted to reveal the components of group dynamics. The study also examined how group dynamics affected team achievements in a virtual environment.

## 2. LITERATURE REVIEW

### 2.1 Team Model and Group Interaction

To create value and combine the creativity of their employees, many organizations rely on the team model [22]. The reason why they depend on the team model is that groups are superior to the individual in many tasks. Although group work is sometimes difficult to manage, the team model contributes to an issue-oriented program or complex issue.

Group interaction is the core of the team model. Group interaction coordinates team members, tasks, and tools [21]. According to the Time, Interaction, and Performance (TIP) theory, group interaction is crucial for the effective coordination of resources among functions and activities in work groups simultaneously performing different functions [30]. In order to facilitate group interaction, a step-by-step approach is needed. Group interaction includes activities such as the construction of a team, setup of goals, exchange of ideas, construction of agreements, and yield of results.

According to Tuckman [37], the development of a group normally goes through the following stages: forming, storming,

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norming, and performing. In the forming stage, the group members get together and they indulge themselves with orientation accomplished. This stage allows group members to identify the boundaries of both interpersonal and task behaviors. The second stage is storming. In this stage, disagreements appear and conflicts happen around interpersonal issues. These behaviors serve as resistance to group influence and task requirements. However, resistance is finally overcome in the norming stage. Cohesiveness developed by members and personal opinions are expressed in the task realm during this stage. The last stage is performing. In this step, group energy is channeled into the tasks. Structural issues have been resolved finally, and the structure can become supportive of task performance. Fisher [23] created a developmental model similar to Tuckman's model. He studied the developmental nature of group discussion and suggested four steps of the developmental model: orientation, conflict, emergence, and reinforcement. Many researchers make rules or strategies for enhancing interactions based on the two studies mentioned above.

Group interaction may be accommodated using computer mediation for an idea-generation task [38]. The distributed asynchronous form of group interaction has obvious benefits. Group members do not have to be physically in the same place to meet, nor must they communicate with one another at the same time. DeRosa et al. [18] examined the influence of electronic communication media on group idea generation tasks and revealed that electronic brainstorming groups are more productive and more satisfied with the interaction process than face-to-face groups.

**2.2 Group Dynamics**

Team members exchange their ideas in order to come up with creative solutions for problems and to generate ideas for future innovations. In such a group process, group dynamics provide an important basis for creative ideas and innovations [32]. Group dynamics are the influential actions, processes, and changes that occur within and between groups [4]. They are psychological processes and the actions of a group engaged in a common endeavor, and they have been recognized as a central branch of social and organizational psychology [17]. Group dynamics are a driving force in promoting the exchange of knowledge and facilitating interactions in project groups. They are expressed in the form of cooperation or creativity. In many fields of research, there is an interest in understanding how group dynamics influence individual behaviors, attitudes, and opinions. Among the group members, there is a state of interdependence through which behaviors, attitudes, opinions, and experiences of one member are collectively influenced by the other group member.

Project members influence each other through group interactions. Group interactions can develop a number of dynamic processes. In order to ensure positive group dynamics, positive stimulus and solidarity between team members are needed. Buchele and Spitz [1] suggested factors of group dynamics in a small group as follows: individual personalities in interaction, group boundaries, leadership, cohesiveness, role differentiation, patterns of communication, emotional relations, norms, climate, values, stages of group development, and sub-

groups. These processes include norms, roles, relations, development, need to belong, social influence, and effects on behavior. Taggar [35] highlighted the importance of team creativity-relevant processes such as inspirational motivation and coordination. Waruszynski [14] suggested that group dynamics are primarily rooted in social psychology that focuses on understanding the cohesiveness of groups, leadership, and group decision processes. Based on integrating previous research, Hoegl and Parboteeah [24] argued that high teamwork quality is related to mutual support in team discussion and individual task work, maintenance of work norms, open communication, fostering group cohesion, and ensuring team members' contributions. Tekleab et al. [36] insisted that team conflict and cohesion strongly influence the ability of team members to interact effectively. Team projects should not always require only a positive process. As shown in Tuckman's and Fisher's study, organizational conflict is important for the purpose of organizational performance.

We have analyzed variables affecting group dynamics using project notes recorded by students. Our finding revealed that the project performance became high when the interaction happened more frequently. In addition, we have found that strong leadership, fierce debates among team members, and strong cohesion promoted productive interaction. Based on previous studies and prior analysis, we suggest the components of group dynamics, as shown in Table 1.

Table 1. The Components of Group Dynamics

Group interaction process			
Tuckman	Form	Storm	Norm
Fisher	Orientation	Conflict	Emergence and reinforcement
Component of group dynamics in each process			
Buchele and Spitz	Leadership, Role differentiation	Patterns of communication	
Tekleab et al.	-	Team conflict	Cohesion
Waruszynski	Leadership	Group decision processes	Cohesiveness of groups
Suggested components of group dynamics			
<b>Researcher</b>	<b>Leadership</b>	<b>Creative friction</b>	<b>Group cohesion</b>

**2.2.1 Leadership**

The first component of group dynamics is leadership. Leadership is the process of social influence in which one person can enlist the support of others in the accomplishment of a common task [2]. Leadership can be divided into two types: task-oriented and relationship-oriented leadership [40].

Task-oriented leadership is a style in which leaders focus on goal achievements and establish well-defined patterns of communication. In contrast, relationship-oriented leadership is a style in which leaders show concern and respect for their followers, look out for their welfare, and express appreciation and support. Since a project team is temporary and has a clear goal, strong leadership is absolutely necessary to facilitate group interaction and solve problems. Task-oriented leadership has a role in promoting collaboration and compliance with rules, and relationship-oriented leadership plays a role in motivating members through encouragement, persuasion, and inspiration. These two types of leadership attract members' attention and yield influence over members.

### 2.2.2 Creative Friction

The second component of group dynamics is creative friction. Project members from diverse specialties bring multiple perspectives and experiences to the project, and thus conflict is sure to occur. Task conflict refers to the disagreements among the group members about the content of the task due to different viewpoints, opinions, and ideas. Relationship conflict refers to interpersonal incompatibilities and frictions among the group members resulting in tension, annoyance, and animosity [26]. Because task conflict increases the quality of decisions, the acceptance of decisions and satisfaction with the group outcome, task conflict is expected to be beneficial for group performance [26].

Creative friction is a dynamic tension between members and team creativity-relevant processes. Creative friction is caused by a task conflict related to the job, and occurs from diverse perspectives [11]. Diverse perspectives, which facilitate idea generation in the eyes of the creative individual, occasionally give rise to conflict [3]. Divergent thinking, one of the defining abilities and personality traits of creative people, comes with diverse perspectives. Guilford [6] proposed four basic categories of divergent thinking: fluency, flexibility, originality, and elaboration. Such an intrinsic state of tension in groups stimulates movement toward the achievement of desired common goals [10]. Additionally, creative friction safeguards against groupthink. Groupthink is a quick and simple decision making method that people use when working in a very cohesive subgroup [9]. It occurs when members strive for agreement. Groupthink hinders group members' evaluation of different or divergent views, and thus causes errors in group decision making. Creative friction stimulates environments for project performance by facilitating idea generation, encouraging rational decision making, and preventing groupthink.

### 2.2.3 Group Cohesion

The last component of group dynamics is group cohesion. Cohesion is defined as a group property with individual manifestations of feelings of belongingness or attraction to the group [12]. Because members who belong to highly cohesive teams may, under certain circumstances, suspend their ability to think individually and express critical ideas, high levels of team cohesion may compromise the quality of team decision making and problem solving [8]. Group cohesion is the strength of the bonds linking individuals to the group and the

degree to which the group members coordinate their efforts to achieve goals [4]. Members who feel team cohesion may believe that they can speak openly about mistakes without fear of negative repercussions [20]. Mullen and Cooper [31] defined a cohesive group with the following characteristics: interpersonal attraction, task commitment, and group pride. Then, they showed that group cohesion affects performance. Group dynamics resulted in strong cohesion based on inter-member acceptance [19]. Therefore, group cohesion can be viewed as the final component of group dynamics. The relationship among components affecting group dynamics can be represented as described in Fig. 1.

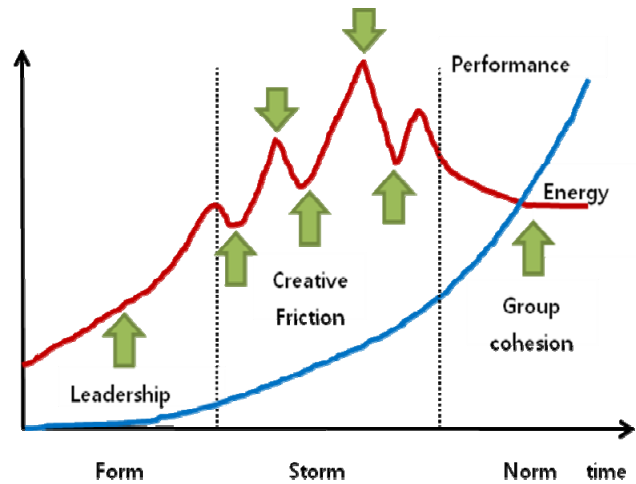


Fig. 1 Mechanisms of Group Dynamics

## 3. HYPOTHESES DEVELOPMENT

The aim of this study was to reveal how group dynamics affect an ICT-mediated team project. Based on previous studies, we suggested that the components of group dynamics were leadership, creative friction, and group cohesion. Then, we set our hypotheses to examine the impact of group dynamics on team achievements through empirical research on ICT-based team projects. The research model is shown in Fig. 2.

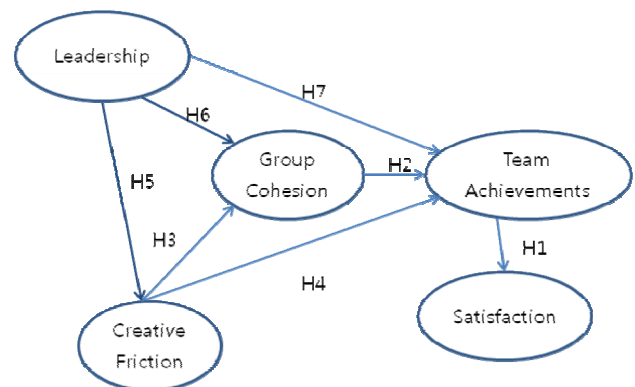


Fig. 2 Research Model

### 3.1 The Relationship between Team Achievements and Satisfaction

Every project team has objectives and endeavors to achieve the intended outcomes. Project outcomes can be divided into physical and psychological outcomes. Physical outcomes are estimated by delivery schedules, budget, and quality of objectives. They are clearly measured and related in some way to the desired outcomes. In an idea generation task, physical outcomes can be measured by quantity and quality of the newly formed ideas. On the other hand, psychological outcomes are related to members' sentiments. Hyatt and Ruddy [25] have noted that members' satisfaction with the team is a critical aspect of group effectiveness. Felps and colleagues [22] insisted that group work can cause poor performance such as low viability and an unhappy team. Members may feel a high level of satisfaction if they achieved a great deal or made progress on the task. Based on this argument, we hypothesized the following:

H1: Team achievements have a positive relationship with satisfaction.

### 3.2 Role of Group Cohesion on Team Achievements

An atmosphere of online communities influences people's intent to participate in online communities and affects the outputs of online communities. Many researchers [29], [31], [39] have already showed that cohesive teams are likely to believe that they perform better. Indeed, if team members escape from the feeling of isolation and antagonism, they can express their opinions actively. If team members become cohesive, they put forth effort to achieve a common goal. Once team members take their fear away and become cohesive, they efficiently collaborate with each other on the team project [31]. Accordingly, the following hypothesis was tested in the study.

H2: Group cohesion has a positive relationship with team achievements.

### 3.3 Role of Creative Friction in Group Cohesion and Team Achievements

Creative thinking is becoming increasingly important in groups [32]. It refers to the ability to take new perspectives on problems and apply persistence to the exploration of new pathways to solve problems [35]. To generate creative thinking, creative friction should be encouraged. Creative friction allows team members to listen to each other, be willing to understand and appreciate conflicting viewpoints, and positively question each other's assumptions [5].

As previously mentioned above, a project team undertakes some steps of team formation. According to Tuckman [37], cohesiveness is formed after disagreements and conflicts around tasks and personal relationships. Once cohesiveness is formed, the structure becomes supportive of task performance. Therefore, it can be assumed that creative friction is positively related with group cohesion.

Interactions involving conflicting viewpoints promote more discussion and critical thinking [27]. Task conflict increases the quality of decisions, acceptance of decisions, and satisfaction with the group outcome, so that task conflict is

regarded as beneficial for group performance [26]. A number of studies on organizational learning and innovation have stressed the positive role of creative friction in facilitating innovation and learning [15]. Innovative companies try to harness the power of divergent viewpoints despite the creative friction between employees that usually occurs [7]. Creative friction facilitates the generation of a wide variety of ideas and responses to a particular problem, so it has a role in improving team achievements. This study proposed hypothesis 3 and 4 as follows.

H3: Creative friction has a positive relationship with group cohesion.

H4: Creative friction has a positive relationship with team achievements.

### 3.4 Role of Leadership on Creative Friction, Group Cohesion, and Team Achievements

In virtual teams, leaders are often the nexus of the team. With proven ability, they take responsibility for task completion and implement team processes. Team project leaders affect group cohesion, norms, and team values. They play a key role in guiding the team members, negotiating conflicts, and motivating them to stay focused, and these activities engage team members in the project process. As stated above, task-oriented and relationship-oriented leadership are both needed for a successful project. Task-oriented leadership influences goal achievements and relationship-oriented leadership creates a positive atmosphere [16]. A team needs a great amount of freedom to create new ideas. However, discipline also needs to work within the confines of reality and stay in alignment with the organization's strategies. Team project leaders can control the team through project discipline or ground rules, and task-oriented leadership can ensure that deadlines are met. Therefore, leaders should create strong discipline and share it with team members [14]. The ability of leaders is essential to shape group cohesion. A leader can build group cohesion by encouragement or inspiration of the members. Under the management of a team leader, creative friction and cohesion are generated. These byproducts and leadership may contribute to achieving the goal. Extending these arguments, we hypothesized the following:

H5: Leadership has a positive relationship with creative friction.

H6: Leadership has a positive relationship with group cohesion.

H7: Leadership has a positive relationship with team achievements.

## 4. METHOD

### 4.1 Research Design

We conducted an empirical study to verify the aforementioned hypotheses utilizing a class at Hanyang University in Korea. The class contained e-learning content designed to foster students' creative thinking and problem

solving skills. One hundred students in various majors were enrolled in the class per semester.

The content provided students with the opportunity to improve their skills in facilitating group decision making processes and assisting groups in achieving productive outcomes. The team project topic was about creative idea generation. The instructor organized small groups of approximately 8 to 10 members so that students were mixed heterogeneously, considering sex, grade, major, and team project experience. A team leader was elected by the consensus of the team and he or she took on the overall coordination of the team. The instructor provided guidelines for the successful implementation of the team project, and the team leader had powerful authority with a penalty system. Evaluation criteria were about the product (such as originality, creativity, and feasibility of outputs) and process (such as the compliance of team rules, frequency of interaction, and degree of participation). A facilitator addressed the important of interaction in teams.

**4.2 Measures of the Constructs and Data Collection**

We have reviewed literature [20], [26], [40] and constructed measurements. The questionnaires were refined through the pilot test. Questionnaires were measured on a five-point Likert scale (1=very strongly disagree, 5=very strongly agree). Items used to measure constructs are shown in Table 2.

Table 2. Items Used to Measure Constructs

Items	Questionnaires
Leadership	Our team leader assigns clear tasks to each group member. Our team leader reminds us of the ground rules and tries to follow them. Our team leader coordinates the activities of the members and encourages us. Thanks to the team leader, our team can clearly understand our responsibilities and accountabilities.
Creative friction	Task-related conflicts happen frequently. We strive to generate divergent opinions and ideas from polarized viewpoints. We feel tremendous tensions while working on the team project. Productive criticism and feedback is frequently proposed by members.
Group cohesion	Our team feels interpersonal attraction. Our team feels a high level of interdependence. Our team has a mutual trust for each other. Our team doesn't feel isolation and antagonism.
Team achievements	Our team achieves intended goals. Our team carries out a successful project. Our team can generate an optimal solution. Our team project is done in a timely and efficient manner.

Satisfaction	I am satisfied with our team project. I am pleased with our performance. I am proud of our team. I think that team project is very useful to us.
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A survey was carried out among the undergraduate students enrolled in the e-learning course. The intention was for students to work in teams on project themes developed in collaboration with other majors. Students were split into teams of six or seven and carried out the team project in forums or chat rooms. The study was conducted three times for different participants. Each study took approximately two weeks and it was carried out in November 2012, May 2013, and November 2013. Students absorbed the project-related knowledge through e-learning courses every 1 hour per week and accomplished the project during two month using different types of online communities such as SNS. After students experienced the project, the survey was carried out. One hundred and ninety four responses among three hundred students were obtained, yielding a response rate of 64.6%. As shown in Table 3, the ratio of males to females was 50.5% to 49.5%. The percentages of freshmen, sophomores, juniors, and seniors were 23.7%, 23.2%, 22.7%, and 30.4%, respectively. Of these respondents, 76.8% had already experienced a team project and 78.9% had taken e-learning courses. While 85.6% of respondents used online communities such as café and club, only 7.2% used an SNS for the team project. The ratio of respondents who experienced team project, e-learning and online community shows that demographics of respondents are appropriate for the analysis of the research model.

Table 3. Demographics of Respondents

		Respondents	%
Semester	2012. 2	71	36.6
	2013. 1	63	32.5
	2013. 2	60	30.9
Gender	Male	98	50.5
	Female	96	49.5
Grades	Freshman	46	23.7
	Sophomore	45	23.2
	Junior	44	22.7
	Senior	59	30.4
Team Project experience	None	45	23.2
	Experienced	149	76.8
E-Learning experience	None	41	21.1
	Experienced	153	78.9
Community Type	SNS	34	17.5
	Online community	160	82.5

**4.3 Reliability and Validity Test**

Statistical data analysis was performed using SPSS 17.0 for factor analysis and reliability analysis. Cronbach's alpha can be considered an adequate index of the inter-item consistency reliability. As shown in Table 4, Cronbach's alpha was found to be greater than 0.70 and it satisfied Nunnally's standard [13]. For convergent validity testing, we used factor analysis. The principal component was analyzed with a varimax rotation to extract multivariate measures of flexibility and its infrastructural supports. As shown in Table 4, factor analysis yielded 5 components with eigen values above 1. As a result of the analysis, we saw an increase from 0.717 to 0.885 and all questions had good loadings on our intended constructs.

Results explained 78.24% of variable dispersion. Next, we conducted confirmatory factor analysis (CFA) to further establish the reliability and discriminant validity of the multi-item scales (see Table 5). The construct validity of the research instrument was assessed via CFA using AMOS 4.0. To perform CFA, we carried out the following activities. First, the measurement model should demonstrate goodness of fit for the empirical data and meet the requirements of certain indexes. The preliminary results showed that we did not obtain satisfactory results in several indices (e.g., CMIN/DF, CFI). CMIN/DF should be less than 2 and the goodness of fit index (GFI) should be larger than 0.9. Thus, we performed CFA analysis again after removing two items (creative friction 4, team achievements 4). The squared multiple correlation (SMC) of the two items was less than 0.04, and the standardized regression value of the two items was less than 0.5. As a result, all fit indices (CMIN/DF = 1.37, GFI = 0.91, AGFI = 0.88, NFI = 0.95, CFI = 0.98, RMSEA = 0.043) were calculated and found to be within acceptable ranges, thus supporting the overall fit of the measurement model (see Table 4). Table 4 shows that the proposed research model has a concrete empirical evidence.

Table 4. Goodness of Fit Indicators for the Measurement Model

$\chi^2$	df	CMIN/DF	p	
171.979	125	1.37	0.003	
CFI	GFI	AGFI	NFI	RMSEA
0.98	0.91	0.88	0.95	0.043

Second, we carried out the convergent validity test. Convergent validity should fulfill the following criteria simultaneously: (1) factor loading for an item should exceed 0.7, (2) construct reliability should be greater than 0.7, and (3) average variance extracted (AVE) for a construct should exceed the reference value of 0.5. As shown in Table 5, all factor loadings of the reflective indicators exceeded 0.7 while construct reliabilities ranged from 0.87 to 0.92 and the AVE ranged from 0.67 to 0.76 (see Table 5). Table 5 shows that items in the questionnaire can measure variables appeared in the research model.

Table 5. Convergent Validity and AVE

	Item	Factor Loading	Estimate /S.E	C.R	AVE
Leadership (L)	TOL4	.851	0.561 /0.087	0.87	0.70
	TOL3	.846			
	TOL1	.833			
	TOL2	.829			
Creative Fiction (CF)	CF3	.834	0.976 /0.132	0.91	0.71
	CF1	.788			
	CF2	.785			
Group Cohesion (GC)	GC4	.885	1.069 /0.129	0.89	0.67
	GC3	.866			
	GC1	.822			
	GC2	.803			
Team Achievements (TA)	TA1	.772	0.564 /0.073	0.90	0.75
	TA2	.770			
	TA3	.717			
Satisfaction (S)	S4	.842	0.589 /0.091	0.92	0.76
	S3	.837			
	S2	.834			
	S1	.828			

We compared the square root of the AVE with the correlations between the constructs. Each construct demonstrated satisfactory discriminant validity when the square root of its AVE value exceeded its correlation with other constructs [26]. As shown in Table 6, each square root of the AVE was greater than the correlations between constructs. Therefore, we could confirm the discriminant validity of the scales (see Table 6). Table 6 shows that each variable in the research model implies different meaning from each other.

Table 6. Discriminant Validity

	L	CF	GC	TA	S
Leadership(L)	0.84				
Creative friction(CF)	0.36	0.84			
Group cohesion(GC)	0.58	0.50	0.82		
Team achievements (TA)	0.49	0.64	0.61	0.87	
Satisfaction(S)	0.31	0.43	0.38	0.59	0.87

Note: Principal diagonal elements correspond to the square root of the average variance extracted (AVE) of each construct; the other figures correspond to the correlations between the constructs.

**5. HYPOTHESIS TESTING**

After the above treatment, the path relationships within the research model were analyzed by structural equation modeling

(SEM) using AMOS 4.0. The result of the SEM is shown in Fig. 2 and Table 7. The goodness-of-fit statistics indicated a good fitting for our model. The  $\chi^2/df$  ratio was 1.538, which was indicative of good fit between the observed and reproduced covariance matrices. The fit indices of the research model were acceptable (GFI=0.904, RMR=0.039, NFI=0.931, TLI=0.975, CFI=0.970, RMSEA=0.053).

In this study, consideration was given to the role of group dynamics. We revealed that team achievements were positively related to satisfaction ( $B=0.544$ ,  $t=8.469$ ) and group cohesion affected team achievements ( $B=0.122$ ,  $t=2.272$ ). Therefore, hypothesis 1 and hypothesis 2 were supported. The results showed that the impacts of creative friction on group cohesion ( $B=0.392$ ,  $t=6.383$ ) and team achievements ( $B=0.265$ ,  $t=3.610$ ) were also significant, and thus hypothesis 3 and hypothesis 4 were also supported. It was also revealed that the impact of leadership on team creative friction ( $B=0.283$ ,  $t=4.889$ ), group cohesion ( $B=0.368$ ,  $t=4.969$ ), and team achievements ( $B=0.348$ ,  $t=6.876$ ) were statistically significant. As a result, our findings showed that leadership, creative friction, and group cohesion had positive relationships with team achievements, and these components of group dynamics had close relations with each other.

Table 7. Parameter Estimate for Research Model

Hypothesis	Standardized Estimate	S.E.	t-value	Result
H1. TA → S	0.544	0.064	8.469**	Supported
H2. GC → TA	0.122	0.053	2.272*	Supported
H3. CF → GC	0.392	0.061	6.383**	Supported
H4. CF → TA	0.265	0.073	3.610**	Supported
H5. L → CF	0.283	0.058	4.889**	Supported
H6. L → GC	0.368	0.074	4.969**	Supported
H7. L → TA	0.348	0.051	6.876**	Supported

Note: Significance levels are denoted as \*\* $p<0.01$ , \* $p<0.05$   
 $\chi^2/df=1.538$ , GFI=0.904, RMR=0.039, NFI=0.931,  
 TLI=0.975, CFI=0.970, RMSEA=0.053

## 6. DISCUSSION AND IMPLICATIONS

### 6.1 Findings and Implications

The usage of ICT that supports group work has increased exponentially. For that reason, group work using a information system has become an important research topic [28, 34]. This research suggested group dynamics as a mechanism for successful team projects and attempted to verify the impact of group dynamics through empirical studies. Focusing on the team level of analysis, we elicited leadership, creative friction, and group cohesion as components of group dynamics based on previous studies and project notes analysis. Then, we

investigated how group dynamics influence team achievements in virtual environments.

The findings from this study suggest that leadership, creative friction, and group cohesion have a positive relationship with team achievements and that these components are closely related to each other in a virtual environment. These results show that 1) group dynamics play an important role in improving project performance, 2) dealing with creative conflict is a way to improve team performance, and 3) leadership plays a key role in a project team. The leader's role goes beyond facilitating to include managing the dynamics of the group with which they are working. The team leaders' and team members' roles and responsibilities should be outlined for the team members. The team leader should clearly define and discuss team member roles, responsibilities, and accountabilities with the entire team. Additionally, the team leader should encourage task-related conflict such as creative friction in order to derive meaningful results from the virtual team project. Team members can express opposition and coordinate different opinions. In the process of adjusting and overcoming conflicts, a team can improve its performance. In addition, this study demonstrates the importance of group cohesion as a factor of a successful team project. Research by Reed and Knight [33] showed that a lack of project group cohesion and hidden agendas is a greater risk for virtual projects than for traditional projects. This research also insisted that individuals within an organization work as a team to achieve a common goal. The results of this study support Reed and Knight's study by demonstrating the importance of group cohesion and leadership through empirical research. It is expected to provide strategies to promote collaboration in the workplace, as well as effective learning through virtual projects. Establishing good group dynamics is a much more complex problem with project teams, but one that must be dealt with if the project team is to be successful.

For the establishment of a collaborative environment, information system should support in-depth discussion and productive collaboration functionally. Thus, group dynamics can be an important research topic in the field of information system as well as strategic leadership. Previous studies have emphasized the importance of group dynamics. However, there were few empirical researches for the components of group dynamics and the actual role of them in a virtual space. Despite the lack of theoretical and empirical support for the connection between group dynamics and team performance, the empirical evidence from this study is expected to provide theoretical and practical implications.

### 6.2 Limitations and Future Research

This study aims to provide new insights regarding group dynamics and present some new results that improve upon past studies. However, it has some limitations. First is the problem of generalization. Because empirical research was conducted in an e-learning class, the results of the study may be generalized to education, but there may be a limit to application for other areas such as companies or R&D organizations. Second, the results of this study may be affected to some extent by the characteristics of the sample, such as team characteristics and cultural backgrounds. Some research evidence shows that

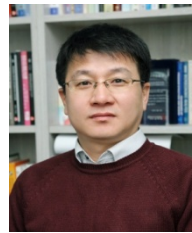
heterogeneous groups outperform homogeneous groups on tasks requiring creativity. Because our empirical research is conducted with a heterogeneous group in terms of gender, grade level, major, and capacity, the results of this study may have explanatory power for heterogeneous groups. Our research was carried out in a collectivistic culture, and collectivistic culture may strengthen leadership and cohesion. Korea has a more collectivistic culture than Western nations. Under a collectivistic culture, being accepted by one's group and following the rules are important. Therefore, there is strong emphasis on cooperation, compliance with the project principles, and a fellowship within the group. Therefore, in order to generalize the results of this study, further research studies should be conducted more widely regarding other factors such as background of members, organizational culture (e.g., collectivistic vs. individual culture), and group characteristics (e.g., heterogeneous vs. homogeneous groups).

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