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**THE MEDIATING ROLE OF KNOWLEDGE SHARING AND TEAM LEARNING
ON THE RELATIONSHIP BETWEEN TRUST, PSYCHOLOGICAL SAFETY, AND
VIRTUAL TEAM EFFECTIVENESS IN THE KOREAN RESEARCH
INSTITUTIONAL CONTEXT**

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ABSTRACT

The primary purpose of this study was to investigate the factors affecting virtual team effectiveness and identify relevant relationships in Korean research institutions. After conducting literature reviews, psychological safety and trust were selected as independent variables, while team learning and knowledge sharing were selected as mediating variables. The research framework identified knowledge sharing and team learning behavior as independent variables and virtual team effectiveness as the dependent variable. Knowledge sharing and team learning behaviors were selected to mediate among psychological safety, trust, and virtual team effectiveness. A survey was distributed to 17 Korean research institutes through a web survey system. Of the 1,008 participants, 288 respondents offered valid data, for a response rate of 28.6%. The collected data were analyzed using regression and bootstrapping. The findings showed that psychological safety, trust, team learning, and knowledge sharing have positive effects on virtual team effectiveness. In addition, team learning mediates relationships between psychological safety team effectiveness, and knowledge sharing mediates relationships between trust and team effectiveness. This result supported findings from prior team effectiveness studies. However, in the virtual team environment, there is a need for strategic efforts that move beyond the traditional team to improve the building of trust and psychological safety.

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Chapter1

Introduction

Statement of the Problem

Contemporary organizations are changing at a rapid pace. In particular, the development of Computer Mediated Communication (CMC) technology has given organizations and teams new characteristics. Virtuality is one of the new attributes of the 21st-century team (e.g., Griffith & Neale, 2001; Griffith, Sawyer & Neale, 2003; Schweitzer & Duxbury, 2010). Due to the globalization and development of communication technology, the use of virtual teams is rising in organizations in the 21st century. According to virtual team surveys, approximately 66% of multinational organizations utilize virtual teams (Society for Human Resource Management, 2012), and 79% of companies used virtual teams as project teams, according to an international survey (Rendón, 2014). Despite this rapid increase, skeptics have voiced concerns about working virtually and whether doing so has a positive impact on team effectiveness in research and conceptual analysis (e.g., Cramton & Webber, 2005; Schweitzer & Duxbury, 2010).

As CMC technology developed, virtual team research initially focused on time and space efficiency, such as schedule flexibility and the ability to work in various locations. However, according to Gilson, Maynard, Jones Young, Vartiainen, and Hakonen (2015)'s virtual team literature review, socio-emotional factors, such as trust,

psychological safety and group cohesiveness, gradually became major research topics. CMC technology has enabled remote collaboration, and this collaboration has allowed team members to solve complex problems by sharing different perspectives among other team members (Funk, 2014). However, this improved collaboration based on time and space efficiency is only the starting point. Han, Chae, Macko, Park, and Beyerlein (2017)'s qualitative study argued that if the foundation of collaboration is based on trust, it creates a team environment in which team members can demonstrate their creativity and solve complex problems. This positive environment is the key to improving team effectiveness.

Most of the work in the organization is changing from simple and individual to a complex, collaborative form (Jacobs, 2017). Scholars argued that a collaborative framework such as knowledge sharing (Kanawattanachai & Yoo, 2007) or team learning (Edmondson, 1999) was essential to the smooth performance of complicated forms of work. Kanawattanachai and Yoo (2007) revealed that generally effective teams tend to share knowledge among team members. Members work within teams to gain knowledge and other resources required to complete tasks assigned to them. Edmondson (1999) defined team learning as the process by which a team takes action, gets feedback, reflects, and makes changes to adapt or improve. Team learning is the process of effectively applying knowledge to perform knowledge-based tasks. This process reduces the gap between abstract knowledge and the task of reality and is a way to improve the creativity of the team. To accomplish a knowledge-based task, knowledge sharing and team learning within the team is essential and exerts a positive impact on team effectiveness.

Socio-cognitive factors such as trust and psychological safety also affect virtual team effectiveness. Although psychological safety and interpersonal trust are used interchangeably, they are strictly distinguishable constructs (Edmondson, 1999). Trust is the expectation that the future behavior of others will be beneficial to their interests. On the other hand, psychological safety refers to the climate in which people feel comfortable. Psychological safety focuses on learning behavior, while trust reduces the need to lower transaction costs and monitor behavior (Kramer & Cook, 2004). Thus, it can be inferred that psychological safety and trust affect not only virtual team effectiveness but also team learning behavior and knowledge sharing, respectively. Ortega, Sánchez-Manzanares, Gil, and Rico (2010) conducted empirical studies on the relationship between team learning and team effectiveness in virtual teams as well as the role of team beliefs about interpersonal context such as psychological safety. Ortega et al. (2010) found that team learning in the virtual project team had a positive impact on team effectiveness.

According to a review of literature by Gilson et al. (2015) of the ten most studied themes over ten years in virtual team research, trust has been one of the most studied topics. How trust forms in situations lacking face-to-face contact, or with insufficient contact, and affects team effectiveness have been of interest to researchers. In particular, trust has been found to be closely related to knowledge sharing (e.g., Liu & Li, 2012; Pangil & Moi Chan, 2014), knowledge transfer, and exchange (Quigley, Tesluk, Locke, & Bartol, 2007). Pinjani and Palvia (2013) showed that knowledge sharing and mutual trust mediate the relationship between diversity levels and team effectiveness. They

proved that knowledge sharing had a partial mediation effect between mutual trust and team effectiveness (Pinjani & Palvia, 2013).

In sum, the development of science and technology is increasing the utilization of virtual teams. Also, the nature of team work is complex due to the number and magnitude of knowledge-based tasks. In this context, there is increasing interest in which factors to consider in efforts to improve virtual team effectiveness. Team learning and knowledge sharing should be considered as part of the team collaboration framework, and psychological safety and trust should be regarded as socio-cognitive aspects of team members. In particular, the relationship between psychological safety and team learning, and the relationship between trust and knowledge sharing, has been proven to be of relevance in previous studies. Therefore, this study aimed to investigate the factors affecting virtual team effectiveness, and how these factors could improve virtual team effectiveness by identifying correlations among them. Findings will demonstrate the relationship between factors.

Purpose of the Study

The purpose of this study was to investigate the factors affecting virtual team effectiveness and to identify the relationships among these factors. These factors were divided into the team collaboration framework (knowledge sharing and team learning) and socio-cognitive dynamics (psychological safety and trust). Then the interrelationships between these factors were investigated, and how each factor affected virtual team effectiveness was examined. For the purpose of collecting meaningful data in virtual team

research, research organizations were targeted in Korea since its Internet technology and diffusion are recognized as among the best in the world.

Research on team effectiveness has been conducted in terms of organization behavior and management. Research on virtual team effectiveness has been based on research on team effectiveness; however, it has highlighted differences between virtual teams and face-to-face teams (e.g., Martínez-Moreno, González-Navarro, Zornoza, & Ripoll, 2009). Currently, virtual teams are no longer a special form of team. The team's virtuality is merely a feature distinguished by the degree of virtuality, which is one team characteristic (e.g., Griffith & Neale, 2001; Griffith, Sawyer & Neale, 2003; Schweitzer & Duxbury, 2010). In this context, the process involves identifying a team's degree of virtuality and defining a certain level of team as a virtual team. Psychological safety and trust were selected as research factors due to the difficulty in building interpersonal beliefs—the frequency of face-to-face contact was low when the degree of team virtuality was high. Knowledge sharing and team learning were factors that correlated strongly with psychological safety and trust. In addition, it was also the most relevant factor in assessing the demand for creativity in modern organizations.

Conceptual Research Framework

This study's conceptual research framework was based on several theories and models that explained the relationships among psychological safety, team learning, trust, knowledge sharing, and virtual team effectiveness. In particular, McGrath (1964)'s input-process-output (IPO) team effectiveness framework, and theories and empirical studies

on the relationship between socio-cognitive constructs, such as psychological safety and trust, and process of group dynamics, such as knowledge sharing and team learning were the main theoretical background for this research.

Structurally, the research framework referred to Edmondson's (1999) model of work team learning and Pangil and Moi Chan's (2014) research model. Both argued that interpersonal belief (psychological safety and trust) was a significant predictor of virtual team effectiveness. Based on the IPO team effectiveness framework, the process of team dynamics (team learning and knowledge sharing) mediated the relationship between interpersonal belief and virtual team effectiveness. Because trust and psychological safety could be completely theoretically distinguished (Kramer & Cook, 2004), trust and knowledge sharing were set as one axis, and psychological safety and team learning were set as the other axis (see Figure 1-1), and the correlation was investigated separately. Through a comprehensive review of the relevant literature regarding psychological safety, team learning, trust, knowledge sharing, and virtual team effectiveness, a hypothesized conceptual research framework has been developed for this study, as presented in Figure 1-1. In the next chapter, theoretical background and research variables (i.e., psychological safe, trust, knowledge sharing, team learning, team effectiveness) and their relationships were discussed in detail.

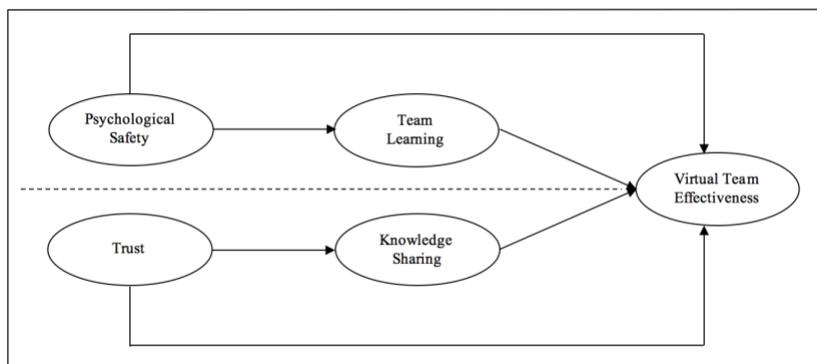


Figure 1-1. *The Conceptual Research Framework for Virtual Team Effectiveness*

Research Questions

To achieve the purpose of the study, the following three research questions were asked and answered:

Research Question 1. Do (a) psychological safety, (b) trust, (c) team learning, and (d) knowledge sharing have positive effects on virtual team effectiveness?

Research Question 2. Does team learning mediate the relationships between psychological safety and team effectiveness?

Research Question 3. Does knowledge sharing mediate the relationships between trust and team effectiveness?

These three research questions were divided into eight statistical hypotheses that are delineated in the next chapter. The hypotheses were as follows:

Hypothesis 1: Trust (cognition-based) has a positive effect on virtual team effectiveness.

Hypothesis 2: Trust (cognition-based) has a positive effect on knowledge sharing.

Hypothesis 3: Knowledge sharing has a positive effect on virtual team effectiveness.

Hypothesis 4: Knowledge sharing mediates partially the relationship between trust and team effectiveness.

Hypothesis 5: Psychological safety has a positive effect on team effectiveness.

Hypothesis 6: Psychological safety has a positive effect on team learning.

Hypothesis 7: Team learning behaviors have a positive effect on team effectiveness.

Hypothesis 8: Team learning behaviors mediate partially the relationship between psychological safety and team effectiveness.

Chapter 2

Review of Related Literature

The purpose of this study was to investigate the relationship among psychological safety, team learning, trust, knowledge sharing, and virtual team effectiveness for Korean knowledge workers who work at research institutions.

This literature review followed the integrative literature review methodology of Torraco (2005). The first step in selecting related literature is to consider: (a) when the search was conducted, (b) who performed the search, (c) how the articles were found, (d) how many articles appeared and the final number of selected articles, and (e) why the articles were finally chosen (Callahan, 2010).

In undertaking the initial research in December 2017, multiple ProQuest databases were used. These included ABI/INFORM Complete, ERIC, ProQuest Education Journals, PsycINFO, and PsycARTICLES. The most relevant articles were extracted using the keyword combinations “psychological safety”, “trust”, “team learning”, “knowledge sharing”, “team effectiveness”, and “virtual”.

Although no specific time period was chosen, only English-language articles were reviewed. The initial search yielded 266 matching articles, which were subsequently pared down using a staged review. During this staged review, only those that included the most in-depth and relevant discussions were chosen for further consideration. One of the primary questions asked was whether a given article investigated the relationship among psychological safety, trust, team learning, knowledge sharing and virtual team

effectiveness empirically or conceptually. If an abstract merely mentioned the relationship without providing an in-depth or relevant discussion, the article was excluded. Through this staged review, 67 articles were selected for further review. Further, the reference lists of searched articles were examined for articles that might not arise in searches of electronic databases. As a result, three books on the concept of team effectiveness, psychological safety and trust were added.

This chapter has the following three sections: (a) theoretical backgrounds of the variables constituting the conceptual framework of the current research, (b) the reviewed relationship among independent variables (psychological safety and trust), mediator variables (team learning and knowledge sharing), and the dependent variable (virtual team effectiveness), and (c) a chapter summary. The first part introduces the major concepts of psychological safety, trust, team learning, knowledge sharing and virtual team effectiveness; the second part reviews literature on the relationships among the constructs of interpersonal team beliefs (psychological safety and trust), team dynamics (team learning and knowledge sharing), and virtual team effectiveness; and the third part summarizes the chapter.

Theoretical Background

This section contains an introduction to the major concepts of psychological safety, trust, team learning, knowledge sharing, and virtual team effectiveness in the workplace context to help with theoretical understandings and operational definitions for the current research.

Conceptualization of Virtuality

The study of virtual teams was divided into two directions. One direction emphasized virtual elements that could be distinguished from those often found in general teams. This direction focused on revealing the uniqueness of virtual teams when compared to face-to-face teams. The other stressed new features of teams in the digital age not limited by time and space. This other direction concentrated on identifying the characteristics of team virtuality. The studies that emphasized the differences among general teams were apt to make relative comparisons between virtual teams and face-to-face teams. Early virtual team research focused on a comparison between face-to-face teams and virtual teams, which were separated by physical distance using technology-based interaction (e.g., Martínez-Moreno, González-Navarro, Zornoza, & Ripoll, 2009). However, this study was suitable to an analysis of small organizations such as a university laboratory, but was not suitable to analyses of large-scale company environments.

On the other hand, the studies that highlighted the identities of modern teams tended to focus on team virtuality as a team's new feature (e.g., Griffith & Neale, 2001; Griffith, Sawyer & Neale, 2003; Schweitzer & Duxbury, 2010). As virtuality became common in all modern teams, how researchers defined virtual teams began to change. Thus, the degree of technology-mediation became a criterion in terms of defining virtual teams. Under all circumstances, team virtuality was a fundamental concept of virtual teams. According to the literature, virtuality was defined in multiple ways. Beth Watson-Manheim, Chudoba, and Crowston (2002) defined virtuality as formed by six types of

discontinuity: temporal, spatial, work group, and organizational, relational and cultural discontinuity. Among them, work group and relationship discontinuities differentiate from others. Work group discontinuity paid attention to the interactions of individuals in different workgroups, while relationship discontinuity focused on the individual state—that is, whether the individual’s employment status was permanent, temporary, self-employed, etc. Espinosa, Cummings, Wilson, and Pearce (2003) pointed out five boundaries that encompassed the attributes of any team, including virtual teams: geographic, organizational, temporal, and functional and identity. Although geographic, organizational and temporal factors were familiar, functional and identity factors were not familiar. Functional and identity boundaries were often crossed by team members. Professionals crossed functional boundaries when they worked with others with different specializations. A professional crossed identity boundaries when he or she belonged to multiple teams. Schweitzer and Duxbury (2010) examined empirical research studies to identify criteria for team virtuality: “1) space/geographic dispersion, 2) organization/boundary-less, 3) time/asynchronicity, 4) term/lifespan, 5) cultural/national diversity, and 6) enabled by/rely on communication technology” (p. 271).

Based on these theories, Schweitzer and Duxbury (2010) measured virtuality on three dimensions. The first dimension was the proportion of team work time spent working virtually. This was the proportion of the team’s task that was performed virtually. In other words, in total time spent at work, time excluding being present at the same time such as face-to-face meetings was divided by total working time. This was not a matter of the physical distance among workers, but of the degree of their virtuality

during actual work. Even if workers were in the same office, a high degree of virtuality was ascribed if they virtually performed without contact, such as virtual meetings.

The second dimension was the proportion of member virtuality. This measured the degree of dispersion of team members. For example, one team had four members. All members worked in one location – 0%. Pairs worked at two locations – 50%. Each of the team's members worked at a different location – 100%. The third dimension was the degree of separation—that is, geographic distance between team members, or the amount and/or effort and/or travel time necessary to meet as a team. A member who is in the same city is much more likely to meet than if she/he is in a different country.

Accordingly, differentiated scores could be given in consideration of travel distance, time, and cost. For example, a score differentiated according to the following criteria: 0.25 for the same city (1/4 day - walk, car, public transit), 0.50 for different regions (1.5 days - car, train, airplane), 1.50 for the same continent (2 days - airplane), 2.00 for different continents - same hemisphere, 3.00 for 2 days – airplane, and 5.00 for different hemispheres (3 or 4 days - airplane).

The items identified by Schweitzer and Duxbury (2010) could be used to measure the degree of virtuality of a team, rather than simply distinguishing between virtual and face-to-face teams. Since higher rates of virtuality were more useful to this study, the focus here was on teams that had a virtuality of 50% or more.

Conceptualization of (Virtual) Team Effectiveness

Team effectiveness refers to the degree to which a team achieves its set goals. It is the degree of satisfaction with the quality, quantity, and timeliness of deliverables from tasks performed by the task team. Team achievement contributes to members' growth and well-being (Hackman, 1987). However, team effectiveness as measured by team performance (e.g., productivity, efficiency, customer satisfaction, job satisfaction, turnover rate, absenteeism, personal growth, etc.) was influenced by complex factors, such as the team's environment and characteristics, characteristics of its members, and diversity of its resources (Cohen & Bailey, 1997). For this reason, various models describing team effectiveness have been developed, and a variety of different criteria have been used to evaluate team effectiveness.

McGrath (1964) presented the input-process-outcome (IPO) model as the framework used most often in basic research. In the IPO model, input combined individual team member characteristics (e.g., competencies, personalities), team-level factors (e.g., task structure, external leader influences), and organizational and contextual factors (e.g., organizational design features, environmental complexity). These various predecessors led to team processes that interact integrally with members to achieve task achievement. In this process, inputs were converted into outcomes, which were the results and by-products of team activity, measured in one or more concepts. In general, outcomes include performance and members' affective reactions such as satisfaction, commitment, and viability.

Ilgén, Hollenbeck, Johnson, and Jundt (2005) developed the input-mediator-outcome (IMO) model based on the IPO model. The IMO model emphasized the temporal factors and dynamics of teamwork in team functioning; the input, which acted as organization, team, and member according to the task, passes through various processes and emergency situations at each stage, describing a series of procedures to be repeated. Using the IMO model from 1997 to 2007, Mathieu, Maynard, Rapp, and Gilson (2008) reviewed the key variables in each factor of team effectiveness research. This concept has recently become more complex and its measurement has evolved. However, in examining the process of input, mediation, and outcomes of the model, little research was found on business performance as a result factor.

Hackman (1987) categorized team effectiveness as the quality and quantity of performance, the improvement of the competence of the members through job performance, and the contribution to growth and welfare of the members. Cohen and Bailey (1997) categorized effectiveness into three parts: performance, attitude, and behaviors. Hoegl and Gemuenden (2001) measured team effectiveness by efficiency, performance, and satisfaction. Nieva, Fleishman, and Rieck (1985) divided team performance into two parts: team level performance (e.g., productivity, efficiency) and individual level performance (e.g., commitment, satisfaction, and turnover). In other words, team effectiveness was largely divided into team performance and members' affect.

Performance was most widely used as the outcome variable of team effectiveness (Bommer, Johnson, Rich, Podsakoff, & MacKenzie, 1995), and performance consisted of member activities and performance results toward achievement of goals (Beal, Cohen,

Burke, & McLendon, 2003). The variables that measure team activities were team process (Kirkman, Rosen, Tesluk, and Gibson (2004), improvement (Kirkman, Rosen, Tesluk, & Gibson, 2004), perceived performance (Jehn & Shah, 1997), and team progressiveness (Kirkman & Rosen, 1999). The results of team activities were employee satisfaction (Kirkman, Tesluk, & Rosen, 2004), and customer satisfaction (Mathieu, Gilson, & Ruddy, 2006) for the team. Role-based performance was evaluated by the competence of members related to the task, team, and organization (Chen, Kirkman, Kanfer, Allen, & Rosen, 2007). In addition, task performance in a mixed form was evaluated according to team members' knowledge, interpersonal skills, and commitment (Barrick, Stewart, Neubert, & Mount, 1998). However, an evaluation of team members and external evaluators, and the evaluation results of various evaluation areas and standards, were difficult to interpret or understand.

In addition, satisfaction with team members and organizational commitment were the most frequently used results in looking at team effectiveness (Kirkman & Rosen, 1999; Tesluk & Mathieu, 1999), cohesion (Barrick, Bradley, Kristof-Brown, & Colbert, 2007), team satisfaction, team atmosphere, team commitment, group cohesion (Balkundi & Harrison, 2006), and learning (Hoegl & Gemuenden, 2001). In this way, team effectiveness was extended to improve both organization performance and the capacity development of the individual through the work process of the team and job satisfaction.

Mathieu et al. (2008) pointed out that team performance and evaluation should be carefully linked to the team's performance evaluation on the basis of amount and quality of work, applying a balanced score card to the evaluation criteria. On the other hand, the self-report method was found to be insufficient in assessing the validity of the team's

work performance, compared to supervisor evaluations (Mathieu et al., 2008). Taken together, a wide variety of concepts and measurement variables were used to measure team effectiveness, and team performance and member satisfaction were the most utilized. Also, to evaluate team effectiveness, it was necessary to utilize external evaluators or to use objective indicators together to supplement the method of conducting team work and investigating attitude. Most studies of virtual team effectiveness included only performance and satisfaction (e.g., Kanawattanachai & Yoo, 2002; Kirkman et al., 2004; Lurey & Raisinghani, 2001).

Based on the literature review, virtual team effectiveness was used to measure team performance and satisfaction.

Conceptualization of Psychological Safety

The psychological safety of the individual and the psychological safety atmosphere of the team were distinguished from one another, and the levels of the concepts differed from one another at individual and group levels (Baer & Frese, 2003). A representative definition of psychological safety, which was an individual-level variable, was that organization members (Khan, 1990) express and apply their own images without worrying about negative effects on the image, position, and career of an individual—the greater the feeling of psychological safety, the greater the level of individual engagement. The psychological safety atmosphere, which was a group-level concept, was mainly identified as a core predictor of organizational innovation, organizational learning, and individual change-oriented behavior (e.g., Baer & Frese,

2003; Edmondson, 1999). This could be seen as a key input variable in the team effectiveness study model.

Psychological safety was a construct distinct from team cohesiveness or trust. Edmondson (1999) defined team psychological safety as the shared belief that the team could safely engage in interpersonal risk-taking. Edmondson (1999) described the psychological safety atmosphere as a team atmosphere in which the entire team made every effort not to embarrass, deny or punish the party for the actions of team members. Team cohesiveness, as opposed to team psychological safety, could be influenced by the team's group thinking, implying a lack of interpersonal risk-taking (Edmondson, 1999). Interpersonal trust was a multidimensional construct composed of cognitive and affective foundations (Lewis & Weigert, 1985). Cognition-based trust involved the calculative and rational characteristics of trustees such as reliability, integrity, and competence (Mayer, Davis, & Schoorman, 1995). Meanwhile, affect-based trust involved the emotional aspects and social skills of trustees. Team psychological safety was conceptually similar to affect-based trust when it was clearly distinguished from cognition-based trust. However, team psychological safety was beyond interpersonal trust. The team climate was characterized by individual trust and mutual respect—that is, people were comfortable with themselves, beyond human relations (Edmondson, 1999).

A team's psychological safety climate was characterized as the inner psychological state of team members formed by positive interactive experiences among them (Edmondson, 2002). The mutual trust and respect among team members ensured shared trust (Edmondson, 1999). The team psychological safety climate played a role in sharing team goals among team members (Jones & Jones, 2011), resulting in positive

motivations to engage in interpersonal interactions (Edmondson, 2002), and facilitate participation in team decision making (Loo & Loewen, 2002). The team's psychological safety facilitated learning behavior among team members, minimizing concerns about team member reactions that could be difficult or threatening (Edmondson, 1999).

Organizational support and coaching for team leaders improved the psychological safety atmosphere, which affected team learning behavior (seeking feedback, error discussion, searching for information and customer feedback) and improved team performance (Edmondson, 1999). Team members could think critically, feel safe, and take risks—important components of learning—in an atmosphere of psychological safety. Mutual respect and trust provided the confidence necessary for learning (Edmondson, 1999).

However, in a team characterized by high virtuality, it was difficult to foster psychological safety due to a lack of communication and intimacy due to the psychological and physical distance between team members. Psychological safety factors were mentioned in the study of virtual team creativity and conditions for success.

Lipnack and Stamps (1999) pointed out that virtual teams experience complications due to physical dispersion, coupled with fluid membership, cultural differences, and lack of prior history. Gibson and Gibbs (2006) found that psychological safety helps to reduce many process losses associated with virtual team work. Ortega et al. (2010) found that psychological safety promoted learning orientation through interactions among members of the project team. Han et al. (2017) also suggested that a virtual team leader should try to create a psychologically safe environment to ensure the success of a virtual team.

Conceptualization of Trust

Trust has been interpreted from different perspectives according to academic traditions. Behaviorists regarded trust as rational choice behavior, such as cooperative choices in a game (Hardin, 1992). Psychologists interpreted trust as complex intrapersonal states that included expectations, intentions, affect, and dispositions (Mayer et al., 1995). Interpersonal trust was a multidimensional construct composed of cognitive and affective foundations (Lewis & Weigert, 1985). Cognition-based trust involved the calculative and rational characteristics of trustees such as reliability, integrity, and competence (Mayer et al., 1995). Meanwhile, affect-based trust involved the emotional aspects and social skill of trustees. Care and concern for the welfare of partners formed the basis for affect-based trust (McAllister, 1995). Affect-based trust had typically been studied in the context of close social relationships, such as those found among couples, family members and friends, while cognition-based trust has been studied in working groups, such as non-profit and profit organizations (Boon & Holmes, 1991).

Cognition-based trust was presumed to be more important in organizations that had both formal and less acquainted work groups. In a virtual team environment, people working in ad-hoc systems tended to focus more on developing the professional role each individual performs, rather than on developing social relationships (Meyerson et al, 1996). In this circumstance, Jarvenpaa and Leidner (1998) revealed that virtual teams must build trust swiftly at the beginning of the teamwork process. Swift trust was defined as a practice involving collective perceptions and abilities related to topics such as risk, uncertainty, vulnerability, and expectations in temporary organizations (Meyerson,

Weick, & Kramer, 1996). Typically, most virtual teams are not continuous entities, and work is inherently interdependent and independent at the same time. These virtual teams share some of the risk due to the interdependence of tasks. Therefore, Meyerson et al. (1996) found that what is crucial to building swift trust is a cognitive and action orientation rather than an interpersonal relationship.

Kanawattanachai and Yoo (2002) argued that virtual teams have “a higher degree of cognition-based trust than affected-based trust” (p. 44). However, swift trust has been shown to be difficult to maintain. There are some reasons for this. First, a lack of experience and history of working with trust among members, and lack of face-to-face contact experience created “a sense of physical and psychological distance among team members” (p. 42). According to Gilson et al. (2015), “swift trust is most likely to be established through initial communication and a positive atmosphere” (p. 1321). It could also affect performance by enhancing trust between “members and subsequent trust” (p. 1321). Suchan and Hayzak (2001) emphasized the importance of a face-to-face meeting in establishing early trust in virtual teams. Notable was that a high performance virtual team and a low performance virtual team could start with the same trust level, but only high performance projects could maintain and develop high trust throughout the project (Kanawattanachai & Yoo, 2002).

According to the literature review, trust was limited to cognition-based trust. This was because affect-based trust overlapped with psychological safety. Also, swift trust was not considered separately. It might be necessary at the beginning of team formation, but it did not affect the entire team life cycle.

Conceptualization of Knowledge Sharing

Knowledge and information were used interchangeably. However, to define the term knowledge sharing, these two terms should be clearly distinguished. According to Nanoka (1994), information was “a flow of messages” whereas knowledge was based on information and justified by one's belief. This was a more comprehensive concept in which knowledge included information, and knowledge has been regarded as something that added know-how to information (Kogut & Zander, 1992).

Knowledge sharing involves knowledge activity. It has been used as a multidimensional concept to denote activity, process, mutual understanding, and behavior. The concept of knowledge sharing influences group performance (Nelson & Coopriider, 1996), an activity that relies on individuals or organizations to share their knowledge with other members of the organization (Ruggles, 1998), which includes knowledge segmentation and transfer, movement, and absorption (Gupta & Govindarajan, 1984). In other words, knowledge sharing behavior refers to the act of assisting and cooperating with other members by providing information and know-how related to the task in order to solve the problem, draw out new ideas, and implement measures or procedures. Knowledge sharing was similar to knowledge transfer and exchange; however, there were some differences between the two. Knowledge transfer was usually used to describe the flow of knowledge between a unit, organization, and department rather than an individual, and knowledge exchange was often referred to as the process of sharing knowledge and the process of exploring knowledge (Wang & Noe, 2010).

According to Nonaka (1994)'s SECI (Socialization, Externalization, Combination, Internalization) model, knowledge circulates constantly from explicit knowledge to tacit knowledge, changing from tacit to explicit. In this process, knowledge is not created only within the individual, but through a dynamic process delivered to others. In other words, knowledge was developed only through the process of sharing knowledge (Nonaka, 1994; Nonaka, Toyama, & Konno, 2000). People created new knowledge effectively through a dynamic knowledge sharing process that exchanged useful experiences, perspectives, and knowledge with others. Furthermore, knowledge sharing promoted individual and group learning (Riege, 2005). In addition, there was a need to consider and discuss issues related to group success, as the driving force for innovation in the team.

However, knowledge sharing is not a natural phenomenon when people gather. This is because people tend to hold knowledge alone or doubt others' knowledge if they consider knowledge to be important and valuable (Davenport & Prusak, 1997). In addition, knowledge sharing does not occur easily when people lack trust or appropriate technical support (Riege, 2005). Virtual teams could amplify this problem due to their complex nature and the remote location of their members. Virtual teams affect the organizational structure (Berry, 2011), and pose unique challenges (Powell, Piccoli, & Ives, 2004). For example, virtual team members are scattered across different geographical locations, and communication and collaboration are done through technology. This could improve efficiency, but many challenges remain, including time issues, feedback delays, misinterpretations, cultural barriers, schedule conflicts, lack of communication, and delayed responses (Jarvenpaa, & Leidner, 1998). These issues could affect the performance of virtual teams if they are not adequately resolved and managed.

Conceptualization of Team Learning

In a management environment where the importance of a team is emphasized, it is necessary for an organization to learn at a team level beyond a personal level in order for a team to exhibit a higher level of flexibility and creativity than an individual. For this reason, Senge (2006), and Watkins and Marsick (1993), asserted that team-level learning is a preemptive factor in organizational learning. The knowledge and experience of the individual is integrated into the team's total assets, and the integrated knowledge is again institutionalized by the team members—a useful resource for individual team members. Team learning also contributes to the achievement of the collective goal of the organization by linking individual-level learning with organizational-level learning.

In examining the literature, it could be seen that team learning has been conceptualized according to three different perspectives. One involved viewing team learning as part of a community of practice (Brown & Duguid, 1991). Another view was considered to be a subset of organizational learning (Senge, 2006). Finally, team learning was conceptualized from a socio-cognitive perspective (Van den Bossche, Gijssels, Segers, & Kirschner, 2006). Edmondson (1999) analyzed previous studies on team learning, and classified the views of team learning as a result and as a process. In looking at team learning results, collective and integrated knowledge was found to be newly constructed through interactions among members while solving business-related problems (Dechant, Marsick, & Kasl, 1993). Team learning as a process involves the process of adjusting and developing team competence (Senge, 2006), and detecting and correcting mistakes in team learning (Argyris & Schön, 1978). Argote, Gruenfeld, and

Naquin (2001) defined team learning as an integrated viewpoint, and defined team learning as a process in which team members interact and share knowledge. In this definition team learning is an integration of results and process perspectives, which includes both behavioral and cognitive perspectives, and encompasses not only the results of team learning but also the meaning of team learning behavior.

In team learning, team members acquire knowledge and skills necessary for their work through interaction and information sharing, which was called team learning behavior (Argote et al., 2001). In other words, as team members become aware of the situation of the team and its goals, they may identify the tasks performed by the team as well as search for related information, establishing a knowledge system and revising and complementing the goals and values of the team through the repetition of these processes (Argote et al., 2001; Edmondson, 1999; Van den Bossche et al., 2006).

The results of empirical studies showed a positive correlation between team learning behavior and team performance (Edmondson, 1999; Van den Bossche et al., 2006). In particular, Ortega et al. (2010) showed that virtual teams were not significantly different, according to previous research. Research on virtual team learning suggested that studies of face-to-face teams could be extended and applied, and that the virtual team could apply the theory on team learning to face-to-face teams (Ortega et al., 2010).

Relationship among Trust, Knowledge Sharing, and Team Effectiveness

Reviewed in this section is the relationship among trust, knowledge sharing, and team effectiveness. Four relationships are explored: (a) the relationship between trust and

team effectiveness, (b) the relationship between trust and knowledge sharing, (c) the relationship between knowledge sharing and team effectiveness, and (d) knowledge sharing as a mediator between trust and team effectiveness.

Trust and Team Effectiveness

The relationship between team trust and outcomes, such as team performance and effectiveness, was positively related (Breuer, Hüffmeier, & Hertel, 2016; Mayer et al., 1995). According to Breuer et al. (2016), team trust was positively related to team-related attitudes (satisfaction with the team, commitment to the team, perceived team cohesion, and effort intentions toward the team), team-related information processing (knowledge sharing and team learning), and team performance (task performance and contextual performance). In a previous study on the relationship between trust and job satisfaction (Dirks & Ferrin, 2002), trust was positively associated with job satisfaction. In Tellefsen and Thomas (2005), trust was shown to increase job satisfaction and commitment and increase job performance. In the above literature review, the team effectiveness construct was composed of team performance and individual satisfaction. Trust had a positive effect on both sides of the team effectiveness construct.

According to the results of the research, trust building was difficult in the virtual environment because team members had no common point in the past and lacked a future reference point as a basis for building trust. Also, asynchrony due to time and geographic distance becomes more difficult. In particular, it has been shown to be difficult to control and adjust individuals in a virtual environment, making trust development difficult

(Powell et al., 2004). An affect-based trust is difficult to build in a virtual environment. Therefore, virtual team members focus on a cognition-based trust based on rational behavior. This type of trust also is difficult to develop within a virtual team. Nonetheless, developing trust among team members is most helpful to team effectiveness; Kanawattanachai and Yoo (2007) showed that cognition-based trust had a significant relationship with virtual team performance.

Therefore, the following hypothesis is based on the above discussions and the empirical studies reported here.

Hypothesis 1: Trust (cognition-based) has a positive effect on virtual team effectiveness.

Trust and Knowledge Sharing

Trust is a belief in the ability, benevolence, and integrity of the other (Jarvenpaa, Knoll, & Leidner, 1998), felt to be of benefit to an individual (Hsu et al., 2007; McAllister, 1995). Knowledge sharing requires confidence among team members who are willing to share their knowledge with and accept the knowledge of peer learners. This trust between peers has also been emphasized in the Nonaka (1994) SECI model, which described the process of creating knowledge in an organization. Nonaka (1994) argued that tacit knowledge was effectively socialized when there was care, affection, trust, and devotion among organizational members, and emphasized the importance of trust in knowledge sharing (Nonaka, 1994; Nonaka et al., 2000). Knowledge sharing is affected by relationships in each party or knowledge group. Although each individual member had

a positive motive for his or her own knowledge sharing behavior, this behavior would not have occurred if one suspected the competence or emotion of the person sharing the knowledge. Therefore, mutual trust should be premised on willingness to impart knowledge and accept the knowledge of others

In a number of studies, trust has been identified as a predictor of knowledge sharing. Thompson, Levine, and Messick (1999) suggested that the higher the level of trust among the members, the more active the flow of knowledge sharing under uncertainty without risk or suspicion. Tsai and Ghoshal (1998) also argued that trust had a direct impact on the exchange of information between teams. Hsu and Chang (2014) explored the facilitation and inhibition factors that affected knowledge sharing in information- and technology-intensive work environments. They developed and distributed questionnaires to information system field workers and verified the structural relationship between variables with a static and a negative impact on knowledge sharing. The results showed that trust significantly promoted knowledge sharing behavior, while uncertainty about the knowledge sharing effects of knowledge providers inhibited knowledge sharing behavior. In addition, social interaction ties and shared knowledge sharing vision were the variables affecting trust, and uncertainty included seeker's absorptive capability concerns and the fear of losing knowledge power.

Therefore, the following hypothesis is based on the above discussions and the empirical studies.

Hypothesis 2: Trust (cognition-based) has a positive effect on knowledge sharing.

Knowledge Sharing and Team Effectiveness

In terms of the organization, knowledge sharing improves at least the personal performance of the knowledge acquirer. Through knowledge sharing, knowledge monopolized by an individual or a specific group is disclosed to other members of the organization. The sharing and utilization of knowledge is an important resource within an organization, enhancing its competitiveness. Through knowledge sharing, organizational members can improve their problem-solving ability in order to perform smoothly, and improve their work efficiency by learning new ideas and approaches about task performance. Organizational members may increase their competence by balancing formal and tacit knowledge through knowledge sharing. In particular, knowledge sharing facilitated the sharing of tacit knowledge acquired by individuals through incentives and rewards at the organizational level. In short, organizations could secure organizational competitiveness by enhancing human resource capacity through knowledge sharing (Nelson & Coopridge, 1996). Knowledge sharing, on the other hand, allowed organizations to securely store their knowledge and increase the efficiency of delivery. In other words, it was possible to reduce the possibility of loss by delegating knowledge storage to several people, and to diversify and access the knowledge sharing channel by sharing knowledge among several people. Increasing the sustainability of knowledge developed its contributions to organizational performance as a long-term, continuous phenomenon rather than a temporary phenomenon.

The results of the empirical study showed that knowledge sharing among members had a positive relationship with member performance (Reychav & Weisberg,

2009). In addition, Chiaburu and Harrison (2008) provided relevant resources relating to sharing knowledge about tasks—sharing knowledge could help members understand the tasks and problems they often experience, improving individual performance and therefore the performance of members participating in the sharing. This was because individuals share knowledge via a virtuous cycle structure, and use the acquired knowledge and information to perform their jobs. It was possible to improve performance by reducing work processing time and increasing productivity, thereby making task execution more effective.

Therefore, the following hypothesis is based on the above discussions and the empirical studies.

Hypothesis 3: Knowledge sharing has a positive effect on virtual team effectiveness.

Knowledge Sharing as a Mediator between Trust and Team Effectiveness

The literature review offered insights into the relationship among trust, knowledge sharing, and team effectiveness. Trust positively affected knowledge sharing and team effectiveness. Knowledge sharing also appeared to have a positive effect on team effectiveness. This suggested that knowledge sharing had partial mediation effects between trust and team effectiveness. According to Ilgen et al. (2005), the team effectiveness framework is an input-mediator-outcome. The IMO model, unlike the existing IPO model (McGrath, 1964), showed that many of the factors that mediated the effects of inputs and deliver results were not processes (Ilgen et al., 2005). While the

team process was related to the behavior of members, the mediation mechanism was better perceived as cognitive, motivational or emotional. In other words, knowledge sharing may be viewed as a mediation mechanism rather than a simple process.

Therefore, the following hypothesis is based on the above discussions and the empirical studies.

Hypothesis 4: Knowledge sharing mediates partially the relationship between trust and team effectiveness.

Relationship among Psychological Safety, Team Learning, and Team Effectiveness

This section reviews literature on the relationship among psychological safety, team learning, and team effectiveness, and explores four relationships: (a) the relationship between psychological safety and team effectiveness, (b) the relationship between psychological safety and team learning, (c) the relationship between team learning and team effectiveness, and (d) team learning as a mediator between psychological safety and team effectiveness.

Psychological Safety and Team Effectiveness

As a result of Edmondson's (1999) study, organizational support and coaching for team leaders improved team members' psychological safety atmosphere, thereby affecting the team's learning behavior (seeking feedback, error discussion, searching for information and customer feedback) respectively. According to Baer and Frese (2003),

organizational leadership, process innovation, and psychological safety were found to influence the company's performance improvement at the company level rather than the team level. In the study, the initiative atmosphere and psychological safety atmosphere contained the effects of the independent variable and effects as the control variable. That is, the two variables influenced process innovation as this relates to company performance. In Wilken and London (2006), eight independent variables, including psychological safety atmosphere, and creativity outcomes and dependent variables of team performance, were hypothesized. In Bradley, Postlethwaite, Klotz, Hamdani, and Brown (2012), psychological safety mood was shown to be a control variable in the impact of task conflict on team performance.

Therefore, the following hypothesis is based on the above discussions and the empirical studies.

Hypothesis 5: Psychological safety has a positive effect on team effectiveness.

Psychological Safety and Team Learning

Scholars defined team psychological safety as a team atmosphere characterized by mutual trust and respect, and their psychological safety played an important role in influencing team learning and learning new customs. For example, Edmondson (1999) clarified the relationship among team structure, psychological safety, efficacy, learning behavior, and performance. In this study, both self-report evaluation and evaluator's evaluation were used. It was found that team psychological safety had a statistically significant effect on self-report evaluation and evaluator's evaluation of team learning

behavior.

Qualitative research confirmed that the main factor in promoting team learning is team psychological safety. Cunha and Louro (2000) stressed the importance of openness and support, suggesting feedback, discussions about mistakes, reflection and experimentation as the driving forces in team learning. In order to ensure that team learning always has a positive effect on team performance, team members should discuss and respond to problems, ask questions, investigate and reflect on external feedback, avoid embarrassment when team members express their opinions, and share beliefs about avoiding punishment and rejection. Learning requires the freedom to engage in experiments and ideas. Edmondson and Nembhard (2009) argued that these behaviors involve interpersonal risks; the mood and conditions involved in mitigating these interpersonal risks require psychological safety.

Therefore, the following hypothesis is based on the above discussions and the empirical studies.

Hypothesis 6: Psychological safety has a positive effect on team learning.

Team Learning and Team Effectiveness

In an empirical study on the relationship between team learning and performance, Argote (2012) reported that team learning behaviors directly affected team cooperative activities and, consequently, team performance. Edmondson et al. (2001) found a positive relationship between team performance and performance using the new method. In a study of 51 working teams in a furniture factory, Edmondson (1999) found that

psychological safety indirectly affected team performance. Van Offenbeek (2001) showed that the extent of team learning behaviors did not have a significant relationship with team performance in a study of 29 teams composed of industrial students, and that team-based activities related to the effect of work on performance. Earley and Gibson (2002) reported that team learning behaviors could effectively transform internal functions and affect team members' satisfaction. Chen et al. (2007), in an empirical study on the effects of learning behaviors on team performance, found that team learning behaviors had a significant effect on team performance. Zellmer-Bruhn and Gibson (2006) suggested that 115 teams from multinational corporations who created new ways of working in international research demonstrated enhanced collaboration due to team learning behavior, and maximized mind-sharing by creating a team advantage.

Therefore, the following hypothesis is based on the above discussions and the empirical studies.

Hypothesis 7: Team learning behaviors have a positive effect on team effectiveness.

Team Learning as a Mediator between Psychological Safety and Team Effectiveness

The relationship among psychological safety, team learning, and team effectiveness was evident in the literature reviewed for this study. Psychological safety positively affected team learning behaviors and team effectiveness. Team learning behaviors also appeared to have a positive effect on team effectiveness. This suggested

that team learning behaviors had partial mediation effects between psychological safety and team effectiveness.

Recent research suggested that team learning was one of the important mediators that explained the relationship between project team characteristics and outcomes (Kozlowski & Ilgen, 2006; Mathieu et al., 2008; Van den Bossche et al., 2006).

Edmondson (1999) reported that learning behaviors mediate the relationship between team psychological safety and team performance. Van der Vegt and Bunderson (2005) also found that team learning mediates the relationship between expertise diversity and team performance in multidisciplinary project teams. De Dreu (2007) found that team learning mediates the effects of collaborative interdependence on team effectiveness.

Therefore, the following hypothesis is based on the above discussions and the empirical studies.

Hypothesis 8: Team learning behaviors mediate partially the relationship between psychological safety and team effectiveness.

Chapter Summary

This chapter reviewed the literature in order to secure a foundational understanding and theoretical justification for this study's purpose, which was to examine the relationships among psychological safety, trust, team learning, knowledge sharing, and virtual team effectiveness. This chapter presented the theoretical backgrounds and importance of each of the research constructs, including virtuality, trust, psychological safety, knowledge sharing, team learning, and virtual team effectiveness. Then, the

conceptual framework was supported by referring to relevant research on similar constructs and relationships to those in the current research. That was, a wide range of HR-related conceptual and empirical assertions was explored that informed this research on the positive directional relationships from socio-cognitive factors (psychological safety and trust) through team dynamics (knowledge sharing and team learning) to virtual team effectiveness. Building on this theoretical basis, this research moved on to examine the established research questions empirically.

Chapter 3

Methods

The purpose of this study was to investigate the impact of psychological safety and trust on team learning and knowledge sharing, and eventually on virtual team effectiveness. In accordance with the overarching research goal and an individual research question, this chapter provided descriptions of instrumentation, including data, variables, and analysis methods, organized according to the research questions.

Data

Instrumentation

Each variable was measured using a validated survey instrument that was developed by other researchers. These instruments were psychological safety, trust, team learning behaviors, knowledge sharing, and team effectiveness. The instruments that were employed in this study used a 7-point Likert-type response scale, and all of the measures reported the perceptions of the survey participants.

Team effectiveness was measured by Lurey and Raisinghani (2001), and Gladstein (1984), using two subscales: team performance and team satisfaction. Team performance included, “In the past, this team has been effective in reaching its goals;” and team satisfaction included, “I feel that my input is valued by the members of the team.” The definitions and measurements for team effectiveness are summarized in Table 3-1.

Table 3-1: Questionnaire Items Measuring Dimensions of Team Effectiveness on a Seven-Point Likert Scale (“strongly disagree” to “strongly agree”)

Dimensions of Team Effectiveness	Definition/Questionnaire Items
Team Performance	<p><i>“the achievement of the team’s task, such as quality, budget, and schedule” (Schweitzer & Duxbury, 2010, p. 284)</i></p> <ul style="list-style-type: none"> • In the past, this team has been effective in reaching its goals. • The team is currently meeting its business objectives. • When the team completes its work, it is generally on time. • When the team completes its work, it is generally within the budget.
Team Satisfaction	<p><i>“the satisfaction of virtual team members with respect to their perceptions that the virtual team experience contributes to their growth and personal well-being” (Schweitzer & Duxbury, 2010, p. 284)</i></p> <ul style="list-style-type: none"> • There is respect for individuals on my team. • I feel that my input is valued by the members of the team. • Team member morale is high in the team. • In the future, I would be interested in participating in another virtual team. • I enjoy being a member of this team. • All in all, I am satisfied with my experiences with this team.

Source: Questionnaire in Appendix B

Psychological safety was measured using seven items that were taken from Edmondson (1999). Psychological safety included, “If you make a mistake on this team, it is often held against you.” The definitions and measurements for psychological safety were summarized in Table 3-2.

Table 3-2: Questionnaire Items Measuring of Psychological Safety on a Seven-Point Likert Scale (“strongly disagree” to “strongly agree”)

Psychological Safety	Definition/Questionnaire Items
	<p><i>“a shared belief that the team is safe for interpersonal risk taking” (Edmondson, 1999, p 354)</i></p> <ul style="list-style-type: none"> • If you make a mistake on this team, it is often held against you. • Members of this team are able to bring up problems and tough issues. • People on this team sometimes reject others for being different. • It is safe to take a risk on this team. • It is difficult to ask other members of this team for help. • No one on this team would deliberately act in a way that undermines my efforts.

Source: Questionnaire in Appendix B

Trust was measured using six cognition-based trust items that were taken from McAllister (1995). Trust included, “I can rely on this person not to make my job more difficult by careless work.” The definitions and measurements for trust were summarized in Table 3-3.

Table 3-3: Questionnaire Items Measuring of Trust on a Seven-Point Likert Scale (“strongly disagree” to “strongly agree”)

Trust (cognition-based)	Definition/Questionnaire Items
	<p data-bbox="574 720 1243 804"><i>“trust that is based on performance-relevant cognitions such as competence, responsibility, reliability, and dependability” (Schaubroeck, Lam, & Peng, 2011, p 864)</i></p> <ul data-bbox="594 816 1409 1125" style="list-style-type: none"> <li data-bbox="594 816 1409 844">• This person approaches his/her job with professionalism and dedication. <li data-bbox="594 846 1409 900">• Given this person’s track record, I see no reason to doubt his/her competence and preparation for the job. <li data-bbox="594 903 1409 957">• I can rely on this person not to make my job more difficult by careless work. <li data-bbox="594 959 1409 1014">• Most people, even those who aren’t close friends of this individual, trust and respect him/her as a coworker. <li data-bbox="594 1016 1409 1071">• Other work associates of mine who must interact with this individual consider him/her to be trustworthy. <li data-bbox="594 1073 1409 1125">• If people knew more about this individual and his/her background, they would be more concerned and monitor his/her performance more closely

Source: Questionnaire in Appendix B

Team learning behaviors were measured using seven items that were taken from Edmondson (1999). Team learning included, “This team frequently seeks new information that leads us to make important changes.” The definitions and measurements for team learning were summarized in Table 3-4.

Table 3-4: Questionnaire Items Measuring of Team Learning on a Seven-Point Likert Scale (“strongly disagree” to “strongly agree”)

Team Learning	Definition/Questionnaire Items
	<p data-bbox="613 1713 1325 1818"><i>“an ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions” (Edmondson, 1999, p. 343)</i></p> <ul data-bbox="631 1831 1409 1885" style="list-style-type: none"> <li data-bbox="631 1831 1409 1885">• We regularly take time to figure out ways to improve our team's work processes.

Team Learning	Definition/Questionnaire Items
	<ul style="list-style-type: none"> • This team tends to handle differences of opinion privately or off-line, rather than addressing them directly as a group. • Team members go out and get all the information they possibly can from others - such as customers, or other parts of the organization • This team frequently seeks new information that leads us to make important changes • In this team, someone always makes sure that we stop to reflect on the team's work process • People in this team often speak up to test assumptions about issues under discussion. • We invite people from outside the team to present information or have discussions with us.

Source: Questionnaire in Appendix B

Knowledge sharing was measured using five items that were taken from Staples and Webster (2008). Knowledge sharing includes, “People in this team are willing to share knowledge/ideas with others.” The definitions and measurements for knowledge sharing were summarized in Table 3-5.

Table 3-5: Questionnaire Items Measuring of Knowledge Sharing on a Seven-Point Likert Scale (“strongly disagree” to “strongly agree”)

Knowledge Sharing	Definition/Questionnaire Items
	<p><i>“the movement of knowledge from one team member to another, typically called transfer, diffusion, distribution – or more commonly – knowledge sharing” (Staples & Webster, 2008, p. 618).</i></p> <ul style="list-style-type: none"> • People in this team keep their best ideas to themselves. • People in this team are willing to share knowledge/ideas with others. • People in this team share their ideas openly. • People in this team with expert knowledge are willing to help others in this team. • This team is good at using the knowledge/ideas of employees.

Source: Questionnaire in Appendix B

All of the measures (i.e., survey questionnaire) adopted for this study were originally developed in English (i.e., original language). Hence, in order to utilize the

measure in the Korean contexts, all measures were translated into Korean (i.e., target language). The translation technique used in this study to ensure adequacy was back-translation, also called double translation or forward- and backward- translation, as explained by McGorry (2000). The process was as follows: (a) one-way translation, (b) double translation, (c) translation by committee, and (d) decentering.

Applying this process, this study followed the steps. The first step was to translate the English version into the target language (i.e., Korean version)—this was done by a bilingual HRD professional who had earned a doctoral degree in the United States. The second step was to translate the target language version back into the original language—this was done by another bilingual HRD professional who had earned a doctoral degree in the United States. In the third step, versions (i.e., English and Korean versions) of the instrument were compared to check for inconsistencies and discrepancies due to the translation process. In the final step, if contradictions or inconsistencies emerged in the translation, both HRD professionals who had translated the instrument were consulted to confirm or correct the translation.

Target Population

Study hypotheses were tested with researchers at Korean research organizations as a target population. The reasons for selecting this group as the target population were as follows. First, Korea's Internet penetration rate and utilization rate is the highest in the world. According to Korea's national indicators (e-National Indicators from Korea, 2015), Korea has the highest Internet access rate (98.8%, including wired and wireless),

followed by the Netherlands (93.6%), Iceland (92.6%), Norway (92.2%), Sweden (90.6%), and Luxembourg (96.6%). Therefore, the development and utilization of CMC technology utilizing the Internet is more active in this country than any other countries. This environment is an important factor in raising a team's degree of virtuality.

Second, the number of Korea's full time equivalent researchers (who engage in actual research and have a bachelor's degree or the equivalent) is 356,447; the full-time equivalent of research and development manpower is 442,027. In 2015, the number of researchers per 1,000 working-age population was 13.2, the highest among major developed countries (e-National Indicators from Korea, 2015).

Third, researchers in research and development organizations engage in knowledge-intensive and flexible work. According to Jacobs (2017), knowledge-based tasks have four major parts: (a) presence of certain complex work situations, (b) sets of information, (c) a need to make decisions about which actions to take, and (d) engagement in those actions. As shown in the components, the knowledge industry that handles information in complex situations requires a high level of expertise and collaboration. In this situation, the existence of a virtual team not limited by time and space was essential. This was a key factor in increasing team virtuality.

Sample

Self-report data were collected from researchers in 17 research organizations throughout South Korea. To identify participants who had experienced virtual collaboration, research institutes were selected that had more than 50 full-time

researchers with more than 3 years of experience. These research institutions had the most high-profile research and learning activities. Researchers with more than three years of experience had had experience with virtual collaboration. Institutions with more than 50 employees were chosen because various types of virtual collaborations were expected to have taken place at institutions of a certain size.

To recruit participants, convenience sampling was used to select 25 colleges and 25 research institutions with more than 50 employees. Gatekeepers, most of whom were in charge of the organization's personnel affairs, were contacted by email or phone. Conversations were scheduled with the gatekeepers to ascertain whether virtual collaboration was being implemented in and encouraged by the organization. The initial contact included an explanation of the study purpose and research questions and a request for permission to conduct the on- line survey. Seventeen organizations agreed to participate in the research.

The gatekeepers were sent a recruitment letter and a URL for the on- line survey. They were also asked to randomly select 50 employees for survey participation—the email addresses of those employees were to be sent to the researcher so that contact could be initiated. Most did not agree to send their employees' email address due to confidentiality concerns, so the gatekeepers were asked to randomly select 50 employees and send an informational recruitment letter and URL for the online survey with an implied informed consent form.

The dependent variable for this study was virtual team effectiveness. This required measuring the degree of virtuality. The virtuality of teams was measured based on self-report questionnaires using three yes-or-no items (see Table 3-6) based on the

degree of virtuality (Schweitzer & Duxbury, 2010). If one or more of the three questions were met, it was considered to be a working experience of the virtual team.

For missing data, the cause of data non-response was carefully considered, and in the case of missing complete at random (MCAR), listwise deletion was used rather than alternative methods (e.g., multiple imputation). The on-line questionnaire was designed to avoid the submission of nonresponses. More than 80% of the respondents were expected to respond to the on-line survey. The remaining 20% were expected to use a paper survey. Non-responses occurred only with the paper survey, which was unavoidable since there was no way to prevent the submission of nonresponses.

Table 3-6: Optional Questions to Identify Virtual Team Experience (“Yes” or “No”)

Dimensions	Definition/Sub-questionnaires
Proportion of team work time spent working virtually	$WV = \frac{\sum \text{hours members spent working virtually}}{\sum \text{hours members spent on team tasks}} \times 100\%$ <ul style="list-style-type: none"> • More than 50% of the time that requires collaboration between team members (e.g., team meeting, exchange of team members) took place in a virtual way.
Proportion of member virtuality	$MV = \frac{\text{Number of different member locations}}{\text{Number of team members}} \times 100\%$ <ul style="list-style-type: none"> • More than 50% of team members worked in different spaces or at different times.
Degree of separation	$DV = \sum \text{members' distance scores* from hypothetical meeting point}$ <ul style="list-style-type: none"> • At least one-half day or more was required to travel to visit team members or for team members to gather in a single place.

Source: Questionnaire in Appendix B

The survey was distributed to 17 Korean research institutions through a web survey system. Of the 1,008 potential participants, a total of 288 respondents were selected due to meeting the criteria for valid data, for a response rate of 28.6%. Demographic information about

the sample was as follows: male, 67.36%; age 30~49, 70.49% (30~39, 38.19%; 40~49, 32.29%); higher education degree, 94.45% (4-year college, 57.99%; graduate school, 36.46%); virtual team work experience of 24 months or more, 58.33%; virtual team member position, 68.75% (see Table 3-7).

Table 3-7: Demographic Information

Variable	Value	Response (<i>n</i> = 288)	
		Frequency	%
Gender	Male	194	67.36%
	Female	94	32.64%
Age	~ 29 years	37	12.85%
	30 ~ 39 years	110	38.19%
	40 ~ 49 years	93	32.29%
	50 years ~	48	16.67%
Education Level	High School	6	2.08%
	2- or 3-year college	10	3.47%
	4-year college	167	57.99%
	Graduate school	105	36.46%
Work Experience of Virtual Team	~ 6 months	14	4.86%
	6 ~ 12 months	39	13.54%
	12 ~ 24 months	67	23.26%
	24 months ~	168	58.33%
Work Position of Virtual Team	Team Leader	90	31.25%
	Team Member	198	68.75%

Variables

The primary purpose of this study was to investigate the relationships among psychological safety, team learning, trust, knowledge sharing, and virtual team effectiveness. Based on the proposed conceptual framework, the primary independent variable of this study was psychological safety and trust, the mediating variable was team learning and knowledge sharing, and the dependent variable was virtual team effectiveness.

Dependent Variable

The dependent variable was virtual team effectiveness. The purpose of this study was to measure virtual team effectiveness as perceived by members. Therefore, team performance and team satisfaction were adopted as dimensions of team effectiveness. Team performance was the most widely accepted dimension in team effectiveness, referred to as “the achievement of the team’s task, such as quality, budget, and schedule” (Schweitzer & Duxbury, 2010, p. 284). Team satisfaction was a result of team activity. Team satisfaction referred to “the satisfaction of virtual team members with respect to their perceptions that the virtual team experience contributes to their growth and personal well-being” (Schweitzer & Duxbury, 2010, p. 284).

Team effectiveness by subject was measured based on self-report questionnaires. In other words, measuring perceived team effectiveness was based on the subject's experience. All subscales were comprised of ten items, and measured using a 7-point

Likert scale ranging from (1) *strongly disagree* to (7) *strongly agree*. Total points were used in the analysis, and ranged from 10 points to 70 points.

Independent Variables

The independent variables in the current research were psychological safety, trust, knowledge sharing, and team learning. Among them, knowledge sharing and team learning were mediating variables as well as independent variables.

Psychological Safety. The term psychological safety referred to “a shared belief that the team is safe for interpersonal risk taking” (Edmondson, 1999, p 354). A team immersed in a psychologically safety atmosphere was fully convinced that they would not be embarrassed, denied or punished for the actions of team members. The psychological safety by the subject was measured based on responses to self-report questionnaires. These items were measured using a 7-point Likert scale ranging from (1) strongly disagree to (7) strongly agree. Total points were used in the analysis, and ranged from a low of 6 to a high of 42 points.

Trust. According to Lewis and Weigert (1985), interpersonal trust was a multidimensional construct composed of cognitive and affective foundations. In this study, affective-based trust was conceptually overlapped with psychological safety. Therefore, trust was limited to cognition-based trust. Cognition-based trust was defined as “trust that is based on performance-relevant cognitions such as competence, responsibility, reliability, and dependability” (Schaubroeck, Lam, & Peng, 2011, p 864). The trust by the subject was measured using self-report questionnaires. These items were

measured using a 7-point Likert scale ranging from (1) *strongly disagree* to (7) *strongly agree*. Total points were used for the analysis, ranging from a low of 6 to a high of 42 points.

Team Learning. Team learning referred to “an ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions” (Edmondson, 1999, p. 343). The team learning by the subject was measured using self-report questionnaires. These items were measured using a 7-point Likert scale ranging from (1) *strongly disagree* to (7) *strongly agree*. Total points were used for the analysis, ranging from a low of 7 to a high of 49 points.

Knowledge Sharing. Knowledge sharing referred to “the movement of knowledge from one team member to another, typically called transfer, diffusion, distribution – or more commonly – knowledge sharing” (Staples & Webster, 2008, p. 618). The knowledge sharing by the subject was measured using self-report questionnaires. These items were measured using a 7-point Likert scale ranging from (1) *strongly disagree* to (7) *strongly agree*. Total points were used for the analysis, ranging from a low of 5 points to a high of 35 points.

Mediating

The mediating variables of the study were team learning and knowledge sharing. According to Baron and Kenny (1986), mediating is defined as a variable that explains the relationship between predictor (independent) variable and outcome (dependent)

variable. Team learning was assumed to mediate the effect of psychological safety on team effectiveness outcomes. Knowledge sharing was assumed to mediate the effect of trust on team effectiveness outcomes. Team learning and knowledge sharing were independent variables as well as mediating variables, because they were influenced by two other independent variables—psychological safety and trust—while at the same time influencing virtual team effectiveness. Psychological safety and trust were assumed to have an impact on virtual team effectiveness directly; therefore, team learning and knowledge sharing were considered to be partial rather than full mediators.

Analysis

This study examined the relationship between all independent variables (psychological safety, trust, team learning, and knowledge sharing) and a dependent variable (virtual team effectiveness), and focused on the mediating effects of knowledge sharing and team learning behavior. In order to test the research question, the data were analyzed using Statistical Package for the Social Sciences (SPSS) version 23.0. To test the mediating relationship, "Macros," which was developed by Hayes (see <http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html>), were downloaded and installed it in the SPSS program. The analysis procedure was as follows: (a) validity and reliability analysis of measurements, (b) descriptive analysis, (c) correlation analysis, (d) hierarchical multiple regression analysis, and (e) testing mediation using bootstrapping.

Research Question 1

Do (a) psychological safety, (b) trust, (c) team learning, and (d) knowledge sharing have positive effects on virtual team effectiveness?

This research question was developed to examine the relationship between all independent variables (psychological safety, trust, team learning, and knowledge sharing) and a dependent variable (virtual team effectiveness). To examine the four independent variables on virtual team effectiveness, multiple regression analysis was used since it met the following three assumptions.

First, multiple regression analysis requires the relationship between the independent and dependent variables to be linear. The linearity assumption can best be tested with scatterplots.

Second, the multiple regression analysis requires that the errors between observed and predicted values (i.e., the residuals of the regression) should be normally distributed. This assumption was checked by looking at a histogram or a Q-Q-Plot. Normality also was checked with a goodness of fit test (e.g., the Kolmogorov-Smirnov test, Shapiro-Wilk test), or skewness and kurtosis values.

Third, multiple regression analysis assumes a lack of multicollinearity in the data. Multicollinearity emerges when the independent variables are too highly correlated with each other. According to Kline (2016), multicollinearity exists when the: (a) correlation coefficient between independent variables is more than 0.9; (b) tolerance is less than 0.1; and (c) variance inflation factor (VIF) is more than 10. Another way to check for multicollinearity is to conduct a correlation analysis to see if the magnitude of the correlation coefficient is less than 0.80.

To test whether a regression relationship existed between the dependent variable and independent variables, the F -test was used. An F -test in regression compares the fits of different linear models. The null hypothesis was $H_0: \beta_1 = \beta_2 = \dots = \beta_{p-1} = 0$, where there were p variables plus an intercept term and, then, $p - 1$ estimates (minus the intercept term). The alternative hypothesis was H_a : at least one differed from 0. The null hypothesis meant that the independent variables had no effect on the dependent variable; therefore, it was called a restricted model. On the other hand, the alternative hypothesis meant the independent variables had an effect on the dependent variable; therefore, it was called a full model. The F -ratio was calculated to test the significance of the overall regression model. A model is significant at the .05 level or better (p -value $\leq .05$), where we reject the null hypothesis in which all regression coefficients are zero.

The coefficient of multiple determination (R^2) was checked to identify the proportionate reduction of total variation in the outcome variable associated with predictor variables between models. In general, the higher the R^2 , the better the model fits the data. Finally, the significance of the regression coefficient for each given independent variable also was inspected.

Research Question 2 and Research Question 3

Does team learning mediate the relationships between psychological safety and team effectiveness?

Does knowledge sharing mediate the relationships between trust and team effectiveness?

The goal of these research questions was to examine whether a mediating relationship existed among the variables in the model. According to Baron and Kenny

(1986), the mediator is a variable that explains the relationship between the predictor (independent) variable and outcome (dependent) variable. Although the approach followed by Baron and Kenny (1986) and the Sobel Test (Sobel, 1982) are often used, there is a movement to change the method of verifying the mediator effect (e.g., Hayes, 2009; Zhao, Lynch, Jr., & Chen, 2010). The reason is the error in the two approaches that has led to use of the alternative bootstrapping method.

Baron and Kenny's (1986) assumption that the independent variable has a significant effect on the dependent variable to verify the mediating effect was not true. Intuitively, there may be a causal relationship in mediating the relationship between the other two variables. However, the views of scholars are gradually converging toward a consensus that this assumption is not correct. For example, the variables M1 and M2 mediate the relationship between X and Y. If the mediating effect M1 is positive, and the mediating effect M2 is negative, both effects will eventually offset each other. As a result, the effect may appear to be insignificant (Hayes, 2013). In terms of the Sobel Test (1982), it fails to capture significant mediating effects by assuming that the sample distribution of the mediating effect is in a normal distribution. As many scholars have noted, the mediated effect, by its corresponding standard error, does not always follow a normal distribution, and thus the test is prone to bias (e.g., Bollen & Stein, 1990; Preacher & Hayes, 2004; Shrout & Bolger, 2002).

In pioneering work from the 1990s onward, Bollen and Stein (1990) showed that bootstrapping can be used to validate mediating effects. However, this approach is becoming increasingly popular among scholars because the development of popular statistical packages, such as AMOS, EQS, LISREL, and Mplus, have streamlined the

process of implementing bootstrapping. Bootstrapping is computer-intensive analysis, also known as the resampling method. This method uses observed data to generate a reference distribution; this distribution is used in confidence interval estimations and significance testing (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). From each of these samples the indirect effect is computed and a sampling distribution can be empirically generated. Because the mean of the bootstrapped distribution will not exactly equal the indirect effect, a correction for bias can be made. With the distribution, a confidence interval, a *p*-value, or a standard error can be determined. Typically, a confidence interval is computed and then checked to determine if zero is in the interval. If zero is not in the interval, then the indirect effect differs from zero. This is conceptually the same as rejecting the null hypothesis that the true indirect effect is zero at the CI = 100% - level of significance. (95% CI = 34; 44)

Preacher and Hayes (2004) developed a “Macros” that simplifies the use of this approach (see <http://www.afhayes.com/spss-sas-and-mplus-macros-and-code.html>) for SPSS. In this study, SPSS with Macros provides adequate bootstrapping analysis and therefore was used. SPSS, SAS, and Mplus macros were downloaded and installed in the SPSS program, for data analyses. Research question 2 set psychological safety as an independent variable (X), team learning as a mediating variable (M), and virtual team effectiveness as a dependent variable (Y). In the same vein, research question 3 set trust as an independent variable (X), knowledge sharing as a mediating variable (M), and virtual team effectiveness as a dependent variable (Y). Next, the standard error must be determined. Macro options provide two options: first order and second order. The first order takes the Sobel test formula; the second order uses the method suggested by

Preacher and Hayes (2004). The macro option was chosen for the second order. The bootstrap was used to perform a 5,000 resample operation.

Chapter Summary

This chapter offered information on data, variables, and analysis. The data section included instrumentation, target population, and sample, explaining specifically which measurement tools were going to be used in collecting data. Variables included dependent (virtual team effectiveness), independent (psychological safety, trust, team learning, and knowledge sharing) and mediating variables (team learning and knowledge sharing). Subsequently, appropriate statistical techniques were selected to test the research questions, and strategies to be used in analyses were described. Multiple regression was chosen to test hypotheses about the relationship between independent variables and one dependent variable. The bootstrapping technique was chosen for use in examining whether a mediating relationship exists among the variables in the model.

Chapter 4

Results

The primary purpose of this study was to investigate into the factors affecting a virtual team effectiveness and identify related relationships in Korean research institutions contexts. The following three research questions guided this study:

Research Question 1: Do (a) psychological safety, (b) trust, (c) team learning, and (d) knowledge sharing have positive effects on virtual team effectiveness?

Research Question 2: Does team learning mediate the relationships between psychological safety and team effectiveness?

Research Question 3: Does knowledge sharing mediate the relationships between trust and team effectiveness?

Study results are reported in this chapter in the following sections: (a) results of measurement testing, (b) results of research questions, and (c) chapter summary.

Results of Measurement Testing

Before analyzing the data, the validity and reliability of the measurements were assessed. This study used measurements whose validity and reliability had been verified in previous studies, meaning that the links between the observed variables and their underlying factors were already clear.

Factor Analysis

Twenty four questions (psychological safety, 6 items; trust, 6 items; team learning, 7 items; and knowledge sharing, 5 items), which affect virtual team effectiveness, were factor analyzed using principal component analysis with Varimax rotation. The analysis yielded four factors explaining a total of 67.182% of the variance for the entire set of variables.

Factor 1 was classified as team learning and knowledge sharing items, which were set as mediating variables in this study. Team learning and knowledge sharing were constructs that had been clearly distinguished through literature reviews, however, they were not accurately divided in the factor analysis. Therefore, it was necessary to check on multi-collinearity. Factor 2 was classified as five items for trust and factor 3 as four items for psychological safety respectively. Psychological safety was defined as the construct that represents the emotional aspects of virtual team members, while trust was defined as the construct that represents cognitive aspects. This was consistent with the hypothesis in the literature reviews. One (TL2) of the team learning questions and one (T6) of the trust questions were separately classified as factor 4. In addition, one (PS2) of the psychological safety questions was not classified as a factor. Therefore, these three questions (TL2, T6, and PS2) were excluded from the regression analysis (see Table 4-1).

Reliability Analysis

To test the internal consistency reliability of each variable, Cronbach's alpha (α) was measured. There is no clear standard regarding acceptable reliability levels, but it is commonly recommended that the Cronbach's coefficient alpha be above .7 (Kline, 2016;

Nunnally, 1967; Peterson, 1994). The Cronbach's alpha values for the variables ranged from 0.81 to 0.94, which are considered acceptably reliable. Compared to the original study, it was similar or slightly higher. The internal consistency reliability value for each variable is presented in Table 4-2.

Table 4-1: Factor Loadings of the Mediating and Dependent Variables

	Factor loadings				Communalities
	1	2	3	4	
KS1	.807	.305	-.011	.032	.745
TL1	.797	.205	.121	.112	.705
KS2	.777	.238	.018	.074	.666
KS5	.768	.313	.035	.060	.692
KS3	.756	.298	.000	.167	.687
TL6	.755	.276	.101	.091	.664
TL4	.741	.276	.078	.187	.666
KS4	.738	.306	.007	-.024	.639
TL7	.715	.248	.099	.183	.617
TL5	.682	.165	.005	.284	.574
TL3	.618	.160	.107	.523	.693
PS2	.447	.389	.377	.018	.494
T2	.223	.752	.073	.196	.659
T3	.298	.730	.183	.121	.671
T4	.413	.730	.079	.097	.720
T5	.326	.695	.095	.219	.646
T1	.471	.674	.102	-.045	.688
PS6	.339	.571	.137	-.069	.464
PS3	-.099	.114	.853	.256	.816
PS1	.112	.144	.851	.098	.768
PS5	-.081	.034	.850	.081	.736
PS4	.246	.163	.776	-.077	.695
TL2	.388	.088	.177	.725	.715
T6	.078	.524	.280	.587	.704

Note. KS: Knowledge sharing, TL: Team learning, PS: Psychological safety, T: Trust. The number in the stub head and stub column means the item number of each variable.

Table 4-2: Reliability Coefficients for Scales of Measurement

Variables	Number of Items	Reliability		
		Original Study	Citation	Current Study
Team Effectiveness	10 (10)	.83	Lurey & Raisinghani (2001)	.94
Psychological Safety	5 (6)	.82	Edmondson (1999)	.81
Trust	5 (6)	.90	Schaubroeck, Lam, & Peng (2011)	.88
Team Learning	6 (7)	.84	Edmondson (1999)	.90
Knowledge Sharing	5 (5)	.83	Staples & Webster (2008)	.91

Note. The numbers in parentheses of the number of items indicated the number of items in the original studies.

Answers to Research Questions

Research Question 1: Do (a) psychological safety, (b) trust, (c) team learning, and (d) knowledge sharing have positive effects on virtual team effectiveness?

The first research question was evaluated using virtual team effectiveness as the dependent variable, and psychological safety, trust, team learning and knowledge sharing as the predictor. First of all, in order to test the normality of the data, skewness and kurtosis values were examined. The skewness values were found to be between $-.747$ and $.004$, and the kurtosis values were shown to be between $.48$ and 1.747 . The normality assumption (i.e., skewness < 2 , kurtosis < 7 ; West, Finch, & Curran, 1995) was well-satisfied.

There were four correlations: virtual team effectiveness and psychological safety, virtual team effectiveness and trust, virtual team effectiveness, virtual team effectiveness and team learning, and virtual team effectiveness and knowledge sharing. The calculation

of Pearson's r showed that all variables were statistically and significantly correlated with each other (see Table 4-3), provisionally enabling this research to move forward to view relationship predictions.

At the same time, however, a strong correlation was detected between the two independent variables ($r = .86, p < .01$), which necessitated a further investigation into the issue of multi-collinearity. To see how severe the issue of multi-collinearity might be, Variation Inflation Factor (VIF) was first calculated. According to Kline (2016), multi-collinearity exists when: (a) the correlation coefficient between independent variables is more than 0.9; (b) the tolerance is less than 0.1; and (c) the variance inflation factor (VIF) is more than 10. The calculation of VIF did not indicate serious multi-collinearity, with all values being less than 10 in every combination of the variables.

The regression analysis showed that psychological safety, trust, team learning, and knowledge sharing accounted for 64.5% of the variation as a significant predictor of virtual team effectiveness. Durbin-Watson was 1.961, so the regression model appeared appropriate. The results showed that trust ($b = 1.135, p < .001$) and knowledge sharing ($b = .577, p < .001$) had a significant positive effect on the virtual team effectiveness.

Overall, the results for the multiple linear regression for research question one indicated a positive effect of trust and knowledge sharing on virtual team effectiveness. These results supported hypotheses 1, 3, 5, and 7. This specific analysis of independent and dependent variables displayed a positive predictor; however, the control variables were less easily qualified and were most statistically insignificant.

Table 4-3. Correlation, means, standard deviations, and unstandardized regression coefficients for the Association of Psychological Safety, Trust, Team Learning, and Knowledge Sharing with Team Effectiveness ($n = 288$)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	<i>Correlations</i>								
<i>Dependent</i>									
1. Virtual Team Effectiveness	1								
<i>Independent</i>									
2. Psychological Safety	.283**	1							
3. Trust	.771**	.397**	1						
4. Team Learning	.632**	.305**	.666**	1					
5. Knowledge Sharing	.683**	.214**	.680**	.857**	1				
<i>Control</i>									
6. Female v male	-.004	.060	.011	.049	.065	1			
7. Graduate School v others	.004	.007	.042	-.067	-.013	-.020	1		
8. >24 mo job duration v <25 mo	.090	.008	.145**	.111*	.132*	-.043	-.077	1	
9. Team leader v team member	-.030	-.027	.008	-.023	-.008	-.150**	.018	.236**	1
	<i>Means & Standard Deviations</i>								
<i>M</i>	48.708	20.976	23.986	28.736	24.389	.33	.36	.58	.31
<i>SD</i>	10.067	5.440	5.129	5.935	5.332	.47	.48	.49	.46
	<i>Simple Least-Squares Regression^a</i>								
<i>b</i>		-.014	1.126**	-.002	.558**				
95%CI of <i>b</i>		[-.158; .130]	[.924; 1.329]	[-.242; .238]	[.286; .830]				
	<i>Least Squares Regression with Control Variables Added^b</i>								
<i>b</i>		-.014	1.135**	-.016	.577**	-.753	-.394	-.594	-.650
95%CI of <i>b</i>		[-.158, .131]	[.930, 1.340]	[-.259, .227]	[.303, .851]	[-2.284, .777]	[-1.882, 1.095]	[-2.093, .905]	[-2.235, .936]

Notes: ** $p < .01$, * $p < .05$ (1-tailed)

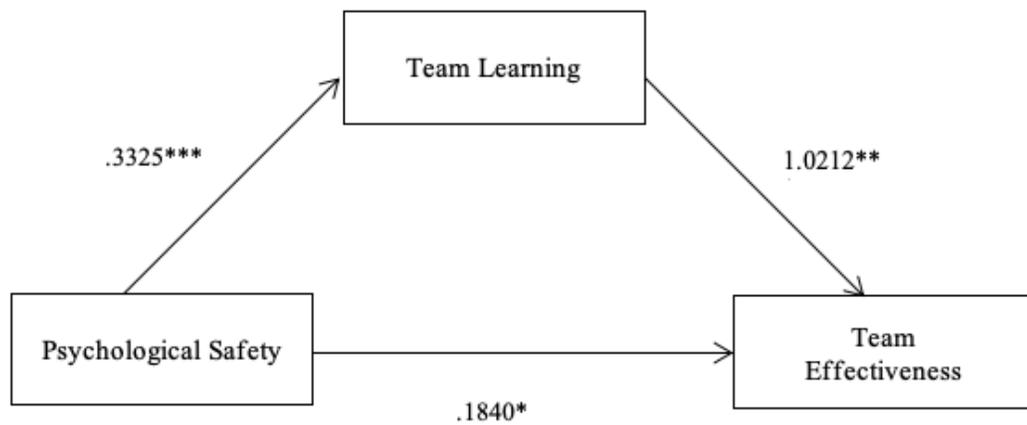
^a $R^2 = .642$, $F(4, 283) = 126.684$, $p < .001$, intercept = 8.429; ^b $R^2 = .645$, $F(8, 279) = 63.324$, $p < .001$, intercept = 9.

Research Question 2: Does team learning mediate the relationships between psychological safety and team effectiveness?

The second research question was evaluated using perceived virtual team effectiveness as the dependent variable, team learning as the mediating variable, and psychological safety as the independent variable. Based on the method proposed by Hayes (2009) to verify the mediating effects of team learning in relation to psychological safety and virtual team effectiveness, regression analysis was used. Based on the model four presented by Hayes (2009), psychological safety was set as an independent variable, team learning as a mediating variable, and virtual team effectiveness as a dependent variable. Covariates (gender, education level, virtual job duration, and position) affected mediating and dependent variables.

As shown in Figure 4-1 and Table 4-4, the effect of psychological safety on team learning was significant ($b = .3325, p < .001$) after controlling for the influence of covariates (gender, education level, virtual job duration). Psychological safety ($b = .1840, p < .05$) and team learning ($b = 1.0212, p < .001$) had significant effects on virtual team effectiveness after controlling for the influence of covariates (gender, education level, virtual job duration). These results supported hypotheses 6 and 8. Psychological safety was a significant predictor of virtual team effectiveness after controlling for the mediator, team learning. Approximately 9.29% of the variance in satisfaction was accounted for

by the predictors ($R^2 = .0929$). The indirect effect was tested using a percentile bootstrap estimation approach with 5,000 samples (Shrout & Bolger, 2002), implemented with the PROCESS macro Version 3.1 (Hayes, 2017). These results indicated the indirect coefficient was significant ($b = .3396$, $SE = .1073$, 95% CI = .1494, .5690). Psychological safety was associated with approximately .3396 points higher virtual team effectiveness scores as mediated by team learning.



Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 4-1. Mediating Effect of Team Learning on Relationship between Psychological Safety and Team Effectiveness

Table 4-4. Total Effect, Direct Effect, Indirect Effect and their Corresponding Bootstrap Confidence Intervals of Team Learning on the Relationship between Psychological Safety and Team Effectiveness

Effect	b	SE	95% CI		R^2	F
			LL	UL		
Total Effect	.5236***	.1050	.3170	.7302		
Direct Effect	.1840*	.0885	.0099	.3582	.0929	29.2939***
Indirect Effect	.3396***	.1073	.1494	.5690		

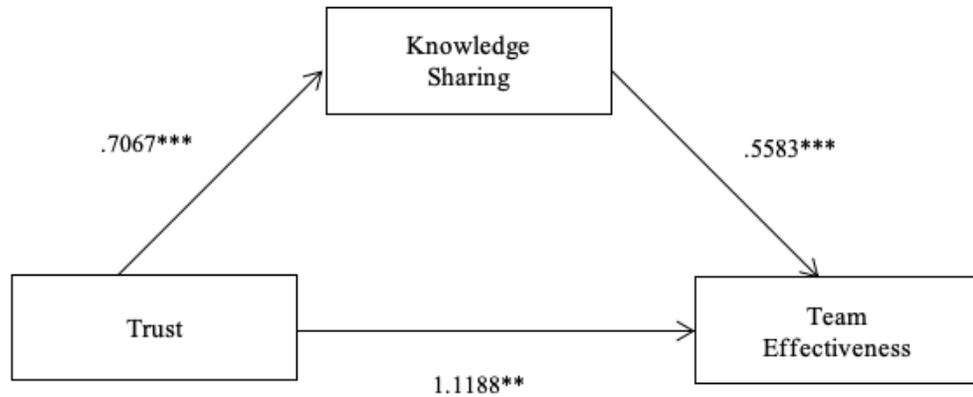
Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; CI = confidence interval; LL = lower limit, UL = upper limit

Research Question 3: Does knowledge sharing mediate the relationships between trust and team effectiveness?

The third research question was evaluated using perceived virtual team effectiveness as the dependent variable, knowledge sharing as the mediating variable, and trust as the independent variable. Based on the method proposed by Hayes (2009) to verify the mediating effects of knowledge sharing in relation to trust and virtual team effectiveness, regression analysis was used. Based on the model four presented by Hayes (2009), trust was set as an independent variable, knowledge sharing as a mediating variable, and virtual team effectiveness as a dependent variable. Covariates (gender, education level, virtual job duration, and position) affected mediating and dependent variables.

As shown in Figure 4-2 and Table 4-5, the effect of trust on knowledge sharing was significant ($b = .7067, p < .001$) after controlling the influence of covariates (gender, education level, virtual job duration). Trust ($b = 1.1188, p < .001$) and knowledge sharing ($b = .5583, p < .001$) had significant effects on virtual team effectiveness after controlling the influence of covariates (gender, education level, virtual job duration, knowledge sharing). These results supported hypotheses 2 and 4. Trust was a significant predictor of virtual team effectiveness after controlling for the mediator, knowledge sharing. Approximately 46.21% of the variance in satisfaction was accounted for by the predictors ($R^2 = .4621$). The indirect effect was tested using a percentile bootstrap estimation approach with 5,000 samples (Shrout & Bolger, 2002), implemented with the PROCESS macro Version 3.1 (Hayes, 2017). These results indicated the indirect coefficient was significant ($b = .3946, SE = .1891, 95\% CI$

= .1301, .8518). Trust was associated with approximately .3946 points higher virtual team effectiveness scores as mediated by knowledge sharing.



Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 4-2. Mediating Effect of Knowledge Sharing on Relationship between Trust and Team Effectiveness

Table 4-5. Total Effect, Direct Effect, Indirect Effect and their Corresponding Bootstrap Confidence Intervals of Knowledge Sharing on the Relationship between Trust and Team Effectiveness

Effect	<i>b</i>	<i>SE</i>	95% CI		<i>R</i> ²	<i>F</i>
			<i>LL</i>	<i>UL</i>		
Total Effect	1.5134***	.0739	1.3679	1.6588		
Direct Effect	1.1188**	.0949	.9320	1.3056	.4621	245.6613***
Indirect Effect	.3946***	.1891	.1301	.8518		

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; *CI* = confidence interval; *LL* = lower limit, *UL* = upper limit

Chapter Summary

Factor analysis and Cronbach's alpha coefficients were adopted to analyze the validity and reliability of the measurements. Based on factor analysis, three question items were excluded from the regression analysis. The regression analysis indicated psychological safety, trust, team learning, and knowledge sharing accounted for 64.2% of the variation as a significant predictor of virtual team effectiveness. Team learning mediate the relationships between psychological safety and team effectiveness. Psychological safety was associated with approximately .3396 points higher virtual team effectiveness scores as mediated by team learning. Knowledge sharing mediated the relationships between trust and team effectiveness. Trust was associated with approximately .3946 points higher virtual team effectiveness scores as mediated by knowledge sharing.

Chapter 5

Discussion and Conclusion

This chapter is composed of the following five sections: (a) summary of research, (b) discussion, (c) the theoretical contributions and practical implications, (d) the limitations of this study and recommendations for future research directions, and (e) conclusion.

Summary of Research

The primary purpose of this study was to investigate the factors affecting virtual team effectiveness and identify relationships in the context of Korean research institutions. Through literature reviews, psychological safety and trust were selected as independent variables, and team learning and knowledge sharing were selected as mediating variables. Many previous studies have influenced analysis of team effectiveness; however, empirical studies on virtual team effectiveness were relatively rare. The following eight hypotheses and three research questions guided this study:

Hypothesis 1. Trust (cognition-based) has a positive effect on virtual team effectiveness.

Hypothesis 2. Trust (cognition-based) has a positive effect on knowledge sharing.

Hypothesis 3. Knowledge sharing has a positive effect on virtual team effectiveness.

Hypothesis 4. Knowledge sharing mediates partially the relationship between trust and team effectiveness.

Hypothesis 5. Psychological safety has a positive effect on team effectiveness.

Hypothesis 6. Psychological safety has a positive effect on team learning.

Hypothesis 7. Team learning behaviors have a positive effect on team effectiveness.

Hypothesis 8. Team learning behaviors mediate partially the relationship between psychological safety and team effectiveness.

Research Question 1. Do (a) psychological safety, (b) trust, (c) team learning, and (d) knowledge sharing have positive effects on virtual team effectiveness?

Research Question 2. Does team learning mediate the relationships between psychological safety and team effectiveness?

Research Question 3. Does knowledge sharing mediate the relationships between trust and team effectiveness?

Based on the research purpose, hypotheses, and questions, instruments for measuring the research variables—psychological safety, trust, team learning, knowledge sharing, and virtual team effectiveness—were selected. They were translated into Korean using strict procedures and with the help of two doctoral students and an expert in the HRD field. The survey was distributed to 17 Korean research institutions through a web survey system. Of the 1,008 potential participants, a total of 288 respondents were selected due to having valid data, for a response rate of 28.6%. The reason for the low response rate was that 28.6% of respondents were eliminated since they did not meet the requirements of the virtual team.

Factor analysis and Cronbach's alpha coefficients were adopted to use in analyzing the validity and reliability of the measurements, and the correlations among variables were analyzed using Pearson's *r*. During the analytical process, the non-occurrence of multicollinearity through tolerance and VIF values was confirmed. To answer the research questions, multiple regression was chosen to test hypotheses about the relationships among a number of independent variables and one dependent variable for the first research question. The bootstrapping technique was selected to examine whether a mediating relationship existed among the variables in the model for the second and third research questions.

To answer the first research question, a multiple regression analysis was conducted. The regression analysis indicated psychological safety, trust, team learning, and knowledge sharing accounted for 64.2% of the variation, indicating that these were significant predictors of virtual team effectiveness.

To answer the second research question, the bootstrapping procedure was performed. Regression analysis was used to investigate the hypothesis that the relationship between psychological safety and virtual team effectiveness was mediated by team learning. Results indicated that psychological safety was a significant predictor of team learning ($\beta = .3325, p < .001$). The regression coefficient between psychological safety and team learning was statistically significant, as was the regression coefficient between team learning and virtual team effectiveness. The indirect effect was $(.3325)(1.0212) = .3396$. It tested the significance of this indirect effect using bootstrapping procedures.

To answer the third research question, the bootstrapping procedure was conducted. Regression analysis was used to investigate the hypothesis that the relationship between trust and virtual team effectiveness was mediated by knowledge sharing. Results indicated that trust was a significant predictor of knowledge sharing ($\beta = .7067, p < .001$). The regression coefficient between trust and knowledge sharing was statistically significant, as was the regression coefficient between team learning and virtual team effectiveness. The indirect effect was $(.7067)(.5583) = .3946$. It tested the significance of this indirect effect using bootstrapping procedures.

The results showed that all hypotheses were supported (see Figure 5-1)

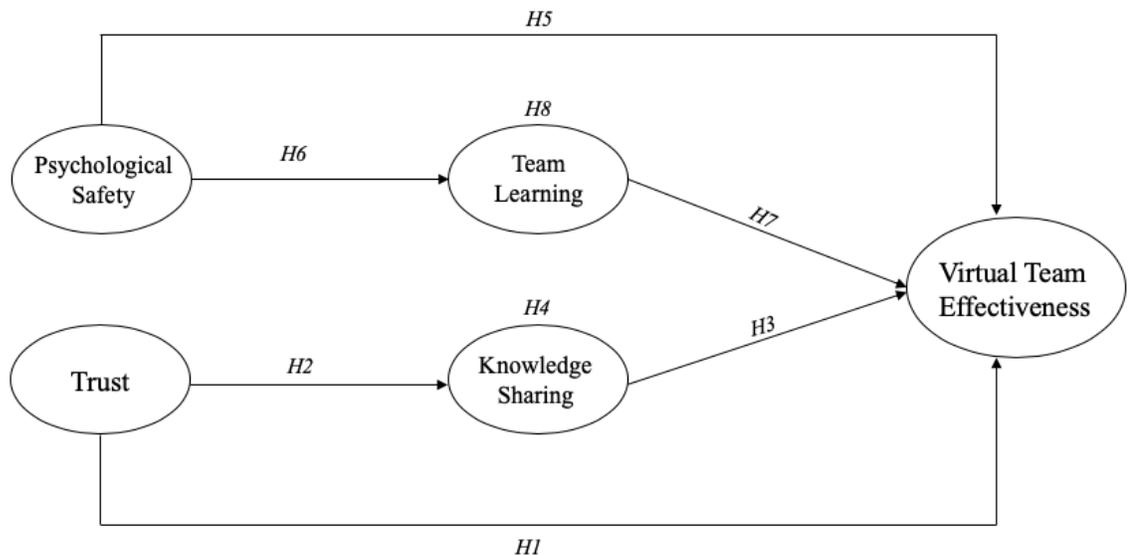


Figure 5-1. The Hypotheses Framework for Virtual Team Effectiveness

Discussion

This study focused on the teams' virtuality and selected only those subjects. Considering the nature of the task, more than 50% of the different time or space work

was considered a virtual team environment, since it also is a characteristic of virtuality. However, virtuality is not just a distant working environment using CMC technology. Rather than identifying the characteristics of the virtual team, which are distinct from the traditional team, this study aimed to examine the changing consciousness of team members according to the changing modern team characteristics.

The first research question sought to examine the effects of psychological safety, trust, team learning, and knowledge sharing on virtual team effectiveness. The findings support previous studies' results, which showed that psychological safety, trust, team learning, and knowledge sharing positively impact on virtual team effectiveness (e.g., Kanawattanachai & Yoo, 2007; Ortega et al. , 2010). This result does not differ from existing traditional team effectiveness studies (e.g., Edmondson, 1999; Pangil & Moi Chan, 2014).

The second and third research questions were developed based on the research models of Edmonson (1999) and Pangil and Moi Chan (2014). In particular, the IPO research framework, the most basic model of team research, has traditionally been used. The purpose of the second research question was to examine the relationship between psychological safety and virtual team effectiveness, and also to investigate the role of team learning as a mediator to this relationship. The finding was consistent with and supported the existing finding (Edmondson, 1999). The purpose of the third research question was to examine the relationship between trust and virtual team effectiveness, and also to investigate the role of knowledge sharing as a mediator to this relationship. The finding also was consistent with and supported current findings (Pangil & Moi Chan, 2014). Interestingly, the relative proportion of direct and indirect effects differed for the

second and third research questions. In the second research question, the direct effect of psychological safety on virtual team effectiveness appeared relatively smaller than the indirect effect of psychological safety on virtual team effectiveness through the mediator of team learning (direct effect = .1840, indirect effect = .3396, total effect = .5326). In the third research question, the direct effect of trust on virtual team effectiveness appeared relatively larger than the indirect effect of trust on virtual team effectiveness through the mediator of knowledge sharing (direct effect = 1.1188, indirect effect = .3946, total effect= 1.5134).

These findings have several explanations. First, because the interpersonal beliefs, such as about psychological safety and trust, are not the same for all individuals. Psychological safety is an emotional-based belief, and trust is a cognition-based belief. Although there are many dimensions of trust (cognition-based, affect-based, personality-based and institution-based), this study examined cognition-based trust to distinguish it from psychological safety. An emotional-based belief, such as psychological safety, is a latent tendency and is shaped into an activity such as team learning. On the other hand, cognition-based trust is an action criterion and may not require a separate activity. According to Pangil and Moi Chan (2014), cognition-based trust has a direct impact on virtual team effectiveness, whereas personality-based and institution-based trust directly and indirectly affects virtual team effectiveness.

The second is due to the environment of the virtual team. Virtual team members work in high-tech environments. They collaborate and rely on each other to solve the common goals and complex tasks assigned to them. Nevertheless, there are limited opportunities for face-to-face contact with each other, so it is difficult to build affect-

based trust. Such an environment requires swift, cognitive and action-oriented trust at the team building level (Meyerson et al., 1996). Therefore, there is a tendency to reinforce the system on the basis of cognitive-based trust.

The final reason for the large difference in the direct effect between the second and third research questions stems from the nature of the work in research institutions. When engaging in knowledge-based tasks such as research, knowledge sharing is a prerequisite rather than a naturally occurring team process. Another difference is that the analysis and processing of information and team learning are more active than knowledge sharing. According to Edmonson (1999), team learning is “an ongoing process of reflection and action, characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions” (p. 343). Based on this definition, team learning is a better reflection of the research process, and therefore is a more appropriate team activity in research institutions.

Implications

Theoretical Implications

A variety of studies have been conducted using the IPO research framework to explore factors that influence team effectiveness (e.g., Ilgen et al., 2005; Mathieu et al, 2008; McGrath, 1964). Since the late 1990s, there have been active studies of the virtual team and team virtuality (e.g., Griffith & Neale, 2001; Griffith, Sawyer & Neale, 2003;

Schweitzer & Duxbury, 2010); however, there have been relatively few empirical studies on virtual team effectiveness. Previously, virtual team studies involved comparisons of online student groups and face-to-face student groups in most lab settings (Gilson et al., 2015). This is the reason why researchers focus on easy-to-find labs or school data. The significance of this study was that it used data from adult vocational organizations, not from student groups. Furthermore, it is more appropriate for the purpose of virtual team research to focus on systematic organizations with common goals, not temporary or random student groups.

The second contribution was a systematic and integrated framework for the relationships among the various factors that affect the effectiveness of virtual teams. This study investigated the factors affecting virtual team effectiveness using multiple regression analysis, and tried to find a combination that maximizes the explanatory power of the independent variables through hierarchical regression analysis. Finally, the bootstrapping technique was used to test the mediating effects. Through this process, relationships among variables affecting virtual team effectiveness were systematically established and demonstrated.

Finally, virtuality is one of the characteristics of the modern team—this study demonstrated that there is no fundamental empirical difference between team effectiveness and virtual team effectiveness. The research design also reflected the concept of virtuality. In an environment in which no more than 50% of time and space are shared among team members, the team performing the tasks using CMC technology was defined as a team having a high degree of virtuality, which means a virtual team. Based on this definition, a virtual team can cover a variety of organizations, such as

project teams or shift teams, to provide a more diverse and flexible framework for organizational research.

Practical Implications

The findings of the empirical analysis offered several practical insights to practitioners. First, practitioners should develop strategies to increase interpersonal beliefs, such as psychological safety and trust in the building of virtual teams. As this study's results showed, psychological safety and trust exert positive impacts on virtual team effectiveness. In particular, a special strategic consideration is essential for teams with a high degree of virtuality to raise interpersonal beliefs. As this study showed, in the virtual team, trust is not easily enhanced by team activity. Previous studies also have introduced special forms of trust, such as swift trust, to build up trust in the virtual team (Jarvenpaa & Leidner, 1998). According to Meyerson et al. (1996); what is crucial to building swift trust is a cognitive and action orientation rather than an interpersonal relationship. At the beginning of the virtual team-building process, clear team goals and work guidelines are important. In addition, quick and fast decision-making and support activities are required by leaders or facilitators.

Second, practitioners should develop and implement strategies for team dynamics, such as team learning and knowledge sharing, to operate virtual teams. As the results of this study showed, team learning and knowledge sharing exert positive impacts on virtual team effectiveness. In addition, the study revealed that team learning mediates the relationships between psychological safety and virtual team effectiveness. Also,

knowledge sharing mediates the relationships between trust and virtual team effectiveness. In order to promote psychological safety and trust, team activities should be specified such as team learning and knowledge sharing. The construction and utilization of knowledge-sharing systems, and the use of joint calendar software for team projects and research are good examples.

Finally, practitioners should develop and implement strategies for CMC technologies. In the context of virtual teams, appropriate technology mix strategies are essential to enabling team dynamics. In particular, there is a need to implement a different technology strategy between the Millennials, who are familiar with technology, and the Baby Boomers, who may not have as much experience with technology (Gibson & Sodeman, 2014). In a virtual team setting, technology is not just a tool. It influences both the working environment and the work context. Thus, mixed strategies for CMC technology should be designed with various factors in mind, such as generation and task characteristics in a virtual team. For example, a team of tech-savvy members can focus on increasing the efficiency of collaboration, such as meetings and scheduling, by using CMC technology more actively. As the nature of the tasks increase in complexity, there is a greater need for the stability which centralized construction offers.

Limitations and Future Research Directions

Although this study contributes to the HRD field theoretically and practically, it had several limitations. First, use of the cross-sectional study design limited the causal relationship between the research variables in this study. Testing mediational hypotheses

with cross-sectional data might be biased and misleading. Researchers should be cautious about interpreting the results, even for hypotheses based on strong theory foundations from the existing literature. Future research needs to consider a longitudinal approach in order to clarify causality.

Second, the convenience sampling method is another limitation of the study. An attempt was made to collect data by contacting as many institutions as possible, but due to the nature of research institutes, access was limited and it was difficult to collect from various samples. The convenience sampling method was used with the recruited research institutes that volunteered to participate in this study. This sampling method might limit the generalizability of the findings. And since the respondents were limited to participants with virtual team experience in the pre-survey stage, it was difficult to collect samples, and the response rate was very low at 28.6%. This sampling method can limit the generalizability of the results. Future research needs to refine the sampling method, and consider participant accessibility.

Third, because the target audience is limited to researchers at Korean research institutes, study findings may only be generalized to those who work in virtual teams. The diversity of the participants is significantly low by race, education level, and industry. Although the target was based on the assumption that the virtual team is widely used in the knowledge industry field, finding bias in the region and the industry was inevitable. In future research, it is necessary to establish a target with diversified samples of multinational corporations and international organizations.

Fourth, this study was theoretically based on the IPO (IMO) model but did not consider team creativity in its research model. While this study measured the results of

team activities with virtual team effectiveness, it is necessary to measure team creativity in cases of knowledge-based team tasks. Hirst et al. (2009) revealed that the greater the extent of the team learning behavior, the greater was the creativity of the team. The real purpose of virtual teams' activities can be understood as the process of identifying and developing different and useful ideas, thereby increasing team creativity and increasing team effectiveness as a result. Therefore, this study was insufficient in offering a comprehensive model of virtual team effectiveness through interpersonal beliefs and team dynamics. Future research should require adding team creativity to the construct of virtual team effectiveness or analyzing the effect of team creativity on virtual team effectiveness. Further research also requires the use of a qualitative or mixed-method approach to understand the process described in this quantitative study.

Conclusion

With the development of globalization and CMC technology, the virtual team is becoming more common in environments characterized by increased organizational virtuality. Under these circumstances, the identification of ways to improve virtual team effectiveness has become one of the major concerns in the organization development field. Based on the IPO (IMO) model, team effectiveness studies showed significant performance both in quantity and in quality. However, research on virtual team effectiveness is not only relatively limited, but there are very few empirical studies of adult work teams. Thus, this study aimed to investigate factors affecting virtual team effectiveness and to identify relationships in the context of Korean research institutions. The

findings showed that psychological safety, trust, team learning, and knowledge sharing have positive effects on virtual team effectiveness. In addition, team learning mediates the relationships between psychological safety and virtual team effectiveness. In addition, knowledge sharing mediates the relationships between trust and virtual team effectiveness. This result supported existing team effectiveness studies. However, in the virtual team environment, there is a need for new strategic efforts to improve the building of trust and psychological safety.

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Appendix A. IRB Exemption Decision Letter



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EXEMPTION DETERMINATION

Date: August 29, 2018

From: Philip Frum,

To: Woongbae Park

Type of Submission:	Initial Study
Title of Study:	The mediating role of knowledge sharing and team learning on the relationship between trust, psychological safety, and virtual team effectiveness in the Korean contest
Principal Investigator:	Woongbae Park
Study ID:	STUDY00009940
Submission ID:	STUDY00009940
Funding:	Not Applicable
Documents Approved:	<ul style="list-style-type: none"> • Revised Version3 (3), Category: IRB Protocol • Survey Questions.docx (0.01), Category: Data Collection Instrument

The Office for Research Protections determined that the proposed activity, as described in the above-referenced submission, does not require formal IRB review because the research met the criteria for exempt research according to the policies of this institution and the provisions of applicable federal regulations.

Continuing Progress Reports are **not** required for exempt research. Record of this research determined to be exempt will be maintained for five years from the date of this notification. If your research will continue beyond five years, please contact the Office for Research Protections closer to the determination end date.

Changes to exempt research only need to be submitted to the Office for Research Protections in limited circumstances described in the below-referenced Investigator Manual. If changes are being considered and there are questions about whether IRB review is needed, please contact the Office for Research Protections.

Penn State researchers are required to follow the requirements listed in the Investigator Manual ([HRP-103](#)), which can be found by navigating to the IRB Library within CATS IRB (<http://irb.psu.edu>).

We would like to know how the IRB Program can better serve you.
 Please fill out our survey; it should take about a minute: <https://www.research.psu.edu/irb/feedback>.

ID:27

Appendix B. Measures for Research Variables

Measure for Team Effectiveness

Items	7 6 5 4 3 2 1
1. In the past, this team has been effective in reaching its goals.	
2. The team is currently meeting its business objectives.	
3. When the team completes its work, it is generally on time.	
4. When the team completes its work, it is generally within the budget.	
5. There is respect for individuals on my team.	
6. I feel that my input is valued by the members of the team.	
7. Team member morale is high in the team.	
8. In the future, I would be interested in participating in another virtual team.	
9. I enjoy being a member of this team.	
10. All in all, I am satisfied with my experiences with this team.	

Note. 1 = strongly disagree, 5 = strongly agree

Measure for Psychological Safety

Items	7 6 5 4 3 2 1
1. If you make a mistake on this team, it is often held against you.	
2. Members of this team are able to bring up problems and tough issues.	
3. People on this team sometimes reject others for being different.	
4. It is safe to take a risk on this team.	
5. It is difficult to ask other members of this team for help.	
6. No one on this team would deliberately act in a way that undermines my efforts.	

Note. 1 = strongly disagree, 7 = strongly agree

Measure for Trust (Cognition-based)

Items	7 6 5 4 3 2 1
1. This person approaches his/her job with professionalism and dedication.	
2. Given this person's track record, I see no reason to doubt his/her competence and preparation for the job.	
3. I can rely on this person not to make my job more difficult by careless work.	
4. Most people, even those who aren't close friends of this individual, trust and respect him/her as a coworker.	
5. Other work associates of mine who must interact with this individual consider him/her to be trustworthy.	
6. If people knew more about this individual and his/her background, they would be more concerned and monitor his/her performance more closely.	

Note. 1 = strongly disagree, 5 = strongly agree

Measure for Team Learning

Items	7 6 5 4 3 2 1
1. We regularly take time to figure out ways to improve our team's work processes.	
2. This team tends to handle differences of opinion privately or off-line, rather than addressing them directly as a group.	
3. Team members go out and get all the information they possibly can from others - such as customers, or other parts of the organization	
4. This team frequently seeks new information that leads us to make important changes	
5. In this team, someone always makes sure that we stop to reflect on the team's work process	
6. People in this team often speak up to test assumptions about issues under discussion.	
7. We invite people from outside the team to present information or have discussions with us.	

Note. 1 = strongly disagree, 7 = strongly agree

Measure for Knowledge Sharing

Items	7 6 5 4 3 2 1
1. People in this team keep their best ideas to themselves.	
2. People in this team are willing to share knowledge/ideas with others.	
3. People in this team share their ideas openly.	
4. People in this team with expert knowledge are willing to help others in this team.	
5. This team is good at using the knowledge/ideas of employees.	

Note. 1 = strongly disagree, 7 = strongly agree

Optional Questions to Identify Virtual Team Experience

Items	1	0
1. More than 50% of the time that requires collaboration between team members (e.g., team meeting, exchange of team members) took place in a virtual way.		
2. More than 50% of team members worked in different spaces or at different times.		
3. At least one-half day or more was required to travel to visit team members or for team members to gather in a single place.		

Note. 1 = yes, 0 = no

VITA

Woongbae Park earned a PhD in the Workforce Education and Development (WFED) Program with an emphasis in Human Resource Development (HRD) and Organization Development (OD) at The Pennsylvania State University.

He has worked in business training for 14 years. He began his career at Samsung Human Resources Development Center and worked for an e-learning company. He engaged in company operations including educational development, operations, human resource management, and marketing.

He received a BA in Chinese philosophy (Confucianism) from Sungkyunkwan University and an MA in business education and training from Korea University in Korea. He studied the intrinsic characteristics of adult learners based on the theory of andragogy. He conducted an empirical study how self-directed learning and quality of programs affect transfer of learning in business e-learning setting.

During the pursuit of a doctoral degree, he served as a graduate assistant in the WFED program at The Pennsylvania State University and engaged in research in multiple areas, including workplace learning, virtual team and virtual HRD and OD.