December 2001

# Built It But They Didn't Come -Investigating Knowledge Sharing and Creation in a Teacher Professional Cyber Community

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# Built It But They Didn't Come –Investigating Knowledge Sharing and Creation in a Teacher Professional Cyber Community

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## Abstract

This paper identifies the contextual factors and causal conditions in determining the inter-organizational learning performance using the grounded theory approach. The study is conducted by investigating the group interaction and performance facilitated by the group supporting system embedded in a community system, called SCTNet, for teachers from different schools. The major findings include interaction among members within a group significantly affects the individual intention of using IT, the causal conditions from individual and group contexts significantly affect the team performance, and inter-organizational knowledge sharing and creation through web-based group support system is restricted by media richness. Several propositions are derived from the research results in explaining the phenomena identified during the group collaboration. These results shed lights on how to facilitate professionals from different organizations to create knowledge through professional cyber community.

**Keywords:** inter-organizational learning, professional cyber community, grounded theory, group support systems, information richness theory

## 1. Introduction

In Taiwan, the elementary educational reform has been moving toward nine-grade joint curricula plan, which integrates learning scope and essential abilities for students from primary to junior-high school education. Within this movement, teachers in primary and junior-high schools are expected to autonomously design classes, flexibly administrate classes and multi-dimensionally evaluate students' learning effectiveness. It becomes urgent for teachers in schools to collaborate to develop lesson plans for subject areas because teachers specialized in certain subjects need to integrate other subjects in order to deliver integrated courses to students. Under the small-school-small-class policy, there is a small number of teachers teaching the same courses within a school. The collaboration of teachers in various specialties and schools can be more diversified and flexible, but it needs to overcome the geographical and organizational barriers. Therefore, it is imperative to use information technology to bridge geographical and organizational barriers.

A teacher professional community web site, called SCTNet (http://sctnet.edu.tw), was established in March 2000 based on the virtual organizational learning (VOL) model (Lin & Lin, 2001). The goal of SCTNet is to provide a cyber space for teachers in compulsory education to share and create professional expertise, to shape the norms and values, and to link teachers with other social stakeholders, such as parents, governmental and non-governmental organizations in achieving the vision of becoming smart creative teachers. SCTNet system was implemented by National Sun Yat-sen University, and co-operated with the Bureau of Education of Kaohsiung City Government. On the SCTNet, teachers can share their professional works in terms of lesson plans, research results, and teaching resources with other community members, and receive comments. Teachers can dialogue on discussion boards in specific subject areas. Teachers with a similar interest can create a

special interest group to collaborate according to their objectives.

While we are moving to the knowledge economy era, some contemporary school reform efforts suggested a shift from the predominant view of schools as bureaucratic organizations to that of schools as communities (Scribner, *et al.*, 1999). The sense of community, extending from teachers within a school to those across schools, stimulates the formation of teachers' professional community. According to Louis, Marks, and Kruse (1996), characteristics distinctive of and critical to teachers' professional community are (1) shared norms and values, (2) focus on student learning, (3) reflective dialogue, (4) deprivatization of practice, and (5) collaboration. By virtue of information technology (IT), teachers in different schools across different geographical regions can communicate and collaborate through Internet. A cyber community embedded with professional community characteristics can be built by utilizing IT in the knowledge economy era to shape the new paradigm of professional practice.

Since the SCTNet debuted, members are found more willing to upload and download resources than dialogue and collaborate on the web. We are puzzled why teachers in the current individual, organizational, and social environmental settings are reluctant to start professional dialogues and collaboration. Although there are several literatures focusing on virtual team collaboration, virtual community, group support systems, the identification of issues in knowledge sharing and creation within inter-school teacher cyber communities is few. It is imperative for researchers to discover essential factors in influencing teachers' knowledge creation in the cyber space. Adopting the grounded theory approach, we identify factors in the individual, group, organizational, inter-organizational, and environmental contexts, which affect the knowledge creation in the teacher professional community, SCTNet, in our study.

## 2. Related Literature Review

The following subsections introduce related research results potentially explaining the puzzled phenomena of low degree of using IT in professional dialogue and collaboration. These can be used for comparing the discovered theories via the grounded theory approach.

### 2.1 Social Presence in Face-to-Face Teams versus Virtual Teams

Many organizations have been adopting "virtual team" approach to team up geographically distributed knowledge workers to collaborate on a variety of workplace tasks. However, many researchers found that virtual teams facilitated by computer meditated communication system (CMCS) exchange information less effectively than face-to-face groups (Hightower and Sayeed, 1996). Warkentin *et al.* (1997) discovered that face-to-face groups have stronger relational links than CMCS groups, and the strength of relational links is positively associated with the effectiveness of information exchange. However, there was no statistically significant difference in the effectiveness of communication measured by information exchange between face-to-face and CMCS groups. Therefore, the loss of relationship building in virtual teams implies that the use of traditional meetings as a supplement to the use of CMCS might be useful for creating a sense of belonging (social presence) to a group. Social presence was defined as the sense of psychological closeness achievable between partners using the medium (Short *et al.*, 1976).

### 2.2 Technology Acceptance Models and Media Richness Theories

Using information technology to facilitate group communication and collaboration is contingent on users' perceived usefulness and ease of use according to the technology acceptance model (TAM) (Davis, 1989; Lederer, *et al.*, 2000). In this study, SCTNet is a web-based information system, which provides a virtual space for school teachers to

communicate and collaborate in professional development.   The phenomenon of low degree of using the SCTNet may be partially explained by TAM.   Therefore, in this study, we will distinguish the influence of perceived usefulness and ease of use from other possible factors in knowledge sharing and creation.

Explained by information richness theory (IRT) in the positivist perspective, face-to-face is the richest medium based on four criteria: *feedback, multiple cues, language variety*, and *personal focus*.   Face-to-face interaction provides immediate feedback so that interpretation can be checked and expressed in natural language, and multiple cues via body language and tone of voice (Daft and Lengel, 1986).   IS research taking an interpretive perspective conceptualizes communication richness as a function of mutual understanding; that is, one person's reaching an understanding of what another person means (Lee, 1994). IRT, amended by a critical social theory (CST) perspective, is not gauged by channel capacity or by how well a receiver recreates a meaning that a sender intends, but instead by how well a receiver succeeds in emancipating him/herself from distorted communications.   The communication richness can be specified by the assessment of the *validity claims* associated with the social actions in an organizational context (Ngwenyama and Lee, 1997).    The community communication and collaboration are intentional behaviors or social actions, and community residents are intelligent actors having their desires and goals.   Therefore, a socio-technical perspective, consisting of technical and managerial efforts, is necessary for explaining the phenomena observed in teachers' collaboration on the SCTNet.

### 2.3 Distributed Knowledge and Group Performance

Rulke and Galaskiewicz's study confirms that group performance is contingent on the distribution of knowledge within the group and networks of social relationships among group members (2000).   Groups that have knowledge broadly distributed across group members (*i.e.*, groups consisting of generalists) will outperform groups that have unique knowledge concentrated in different group members (*i.e.*, groups consists of specialists).   Group members with shared knowledge may minimize effort to retrieve information they need from each other, and information contribution may also provide retrieval cues to aid knowledge transfer (Liang, Moreland, and Argote, 1995).   Moreover, they are more likely to share conceptualizations of one another's expertise, which, in turn, contribute the group performance (Gruenfeld *et al.*, 1996; Stasser, Stewart, and Wittenbaum, 1995).

In testing if group structure modifies the effect of knowledge distribution on performance, Rulke and Galakiewicz found that the performance of generalist groups did not vary across group structures (centralized versus decentralized); however, decentralized groups outperformed centralized groups when groups were composed mostly of specialists. Decentralized network structures should help groups of specialists to overcome their lack of common knowledge and understanding.   Knowledge sharing in a structural or network perspective can be examined based on transactive memory to identify the role in assigning knowledge and to help to retrieve knowledge when need arises (Wegner, 1986).

Group performance may also contingent on the trust building between team members. In the global virtual team settings, Javenpaa *et al*. (1998) investigated the antecedents of trust, and found that team trust is a function of members' ratings of the other team members' perceived ability, integrity, and benevolence, as well as of the members' own propensity to trust.   Swift trust may be a by-product of a highly active, proactive, enthusiastic, generative style of action.   The trust may decrease almost immediately because team members lack action and initiative.   Hence, action seems to be an important antecedent as well as an outcome of trust.

## 3. Research Methodology

Grounded theory approach (Glaser and Strauss, 1967; Strauss and Corbin, 1990; Martin and Turner, 1986; Pandit, 1996) has its origins in studies of professional and organizational settings, and provides a systematic way of developing theory explaining the occurrence of phenomena. In investigating the phenomena and elaborating theory explaining the inter-organizational learning model through teachers' collaboration in designing lesson plans, we adopt the grounded theory approach utilizing its uniqueness in inductive, contextual, and processual traits.

### 3.1 Design of Study

We launched a seven-week on-job training project by calling primary school teachers in Kaohsiung City to collaboratively design lesson plans. In the first two weeks, two instructors introduce the strategies and practices to adopting IT to teaching. In the next five weeks, every five to seven teachers form a team to design lesson plans, which are integrated with IT. A team is composed of participants with approximately similar combination of characteristics, such as interesting subjects, seniority, specialty, computer efficacy, and acquaintance. Team A chooses to develop lesson plans in social study, Team B to D choose science, and Team E to F choose literacy. Each team was granted with high flexibility to elect its team leader, to develop a lesson with a variety of tools and scenarios, and to set the goal to reach within the five-week collaboration. Teachers within the same team came from different schools and did not know each other until joining the team. Although they may spend at least one hour driving to meet face-to-face, it is necessary for them to communicate and continue tasks while they cannot get together. This brings the role of the special interest group (SIG) in SCTNet. SIG enables group communication and collaboration by offering group supporting mechanisms, such as discussion board, message board, e-mail, resource sharing and exhibition. Besides SIG's facilitation, teams are immersed in the SCTNet community, where teaching related resources are distributed, and the cyber community residents get to know each other on the SCTNet.

According to studies from group dynamics, we suggested several activities for teams to increase group cohesion, such as to "draw" a group portrait to impulse team members to introduce themselves in details, to record group progress in SIG from time to time as team memory, and to respond to messages in a timely fashion.

### 3.2 Data sources and procedures

Data are collected along with the project execution via various means:
1. Information shared in SIGs of the SCTNet,
2. Observation during team meeting,
3. Questionnaires filled out at different stages, and
4. Semi-structured interviews to each team by selecting the team leader, one most and one least active members.

Each participant filled out three questionnaires during the beginning, middle, and end of the project respectively. The first questionnaire was used for collecting basic personal information. The main purpose of the first questionnaire is used for assigning participants to teams in order to make each team have approximately similar team member composition. The second questionnaire was used for collecting contextual data regarding individual, group, organizational, and environmental. The experiences of using SCTNet as IT context, and the personal viewpoint to this team collaboration project were asked as well. The third questionnaire was used for evaluating team goal attainment, efficacy in using IT for teaching, knowledge sharing and creation process, and comments to this collaborative project.

The semi-structure interviews were conducted by three co-authors of this paper through

telephone one week after the project ended.   Since the information cannot obtain from SIG completely, we combined the information collected from interviews with what SIG logged to reach a thorough view of team interaction.

### 3.3 Data analysis

The process of open, axial, and selective coding (Strauss and Corbin, 1990), which resulted in descriptive themes, guided our analytic procedure.   To obtain trustworthiness of research findings as Lincoln and Guba (1985) suggested, we used multiple data sources, codified data collectively, and maintained a detailed research record.   We adopted "triangulation" approach, which utilizes quantitative data or combines qualitative and quantitative techniques of analysis (Strauss and Corbin, 1990; Orlikowski, 1993). According to Glesne and Peshkin (1992), qualitative researchers can situate on a continuum from observer to participant.   Thus, the first author of this paper was the lead facilitator (i.e., participant) of this team collaboration project.   The other three authors played observer roles, taking primary responsibility for interviewing and SIG's data analysis.   The four researchers cooperatively performed the open, axial, and selective coding, and evaluated team performance.
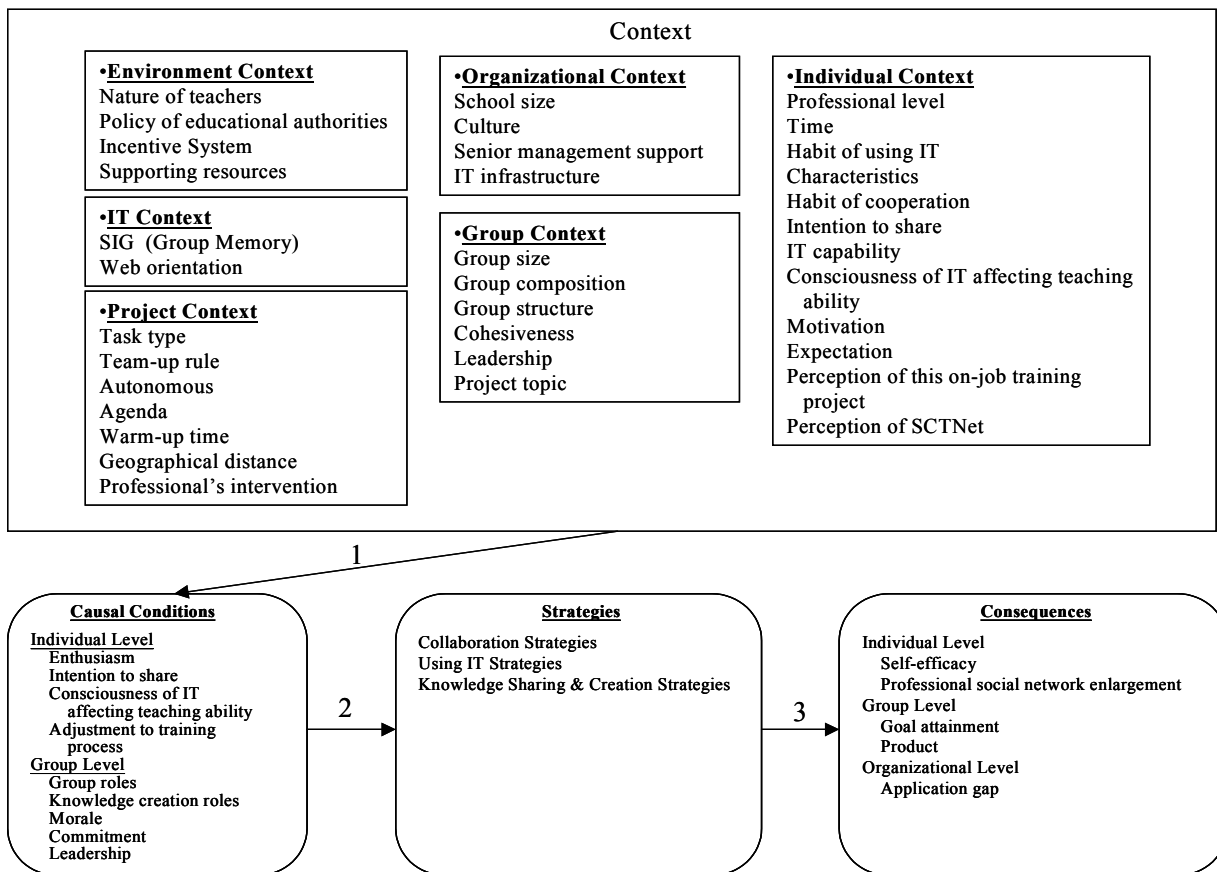


**Figure 1. Research model of inter-organizational knowledge sharing and creation**

## 4. Research Results

Figure 1 depicts the categories and concepts developed from iteration between data and concepts.   On the top is the context for inter-organizational knowledge sharing and creation. Among these contexts, several factors that become the causal condition (arrow 1) affect the strategies that the team adopts (arrow 2), and thus the consequences of inter-organizational knowledge sharing and creation are different (arrow 3).   The causal conditions consist of

two levels: individual level (enthusiasm, intention to share, consciousness of IT affecting teaching ability, and adjustment to training process) and group level (group roles, knowledge creation roles, morale, commitment, and leadership styles).  Three group action/interaction strategies to reach team objectives are collaboration, using IT, and knowledge sharing and creation strategies.  The consequences are viewed in individual level (self-efficacy and professional social network enlargement), group level (goal attainment and product quality), and organizational level (application gap).

### 4.1 Contexts

In this subsection, we discuss the contexts for inter-organizational learning codified in this study: *environmental, organizational, group, individual, project*, and *IT*.  The important findings of these contexts are highlighted as follows.

#### 4.1.1  Environmental context

Within the environmental context, we portray the current Taiwan's education environment from the nature of teachers' work, national education policies, incentive systems, and supporting resources.  The academic degree of the primary school teachers is above college.  The culture of primary school teachers' communities encourages teachers to be sympathetic, so that they usually take a positive attitude toward others.  For example, a participant explained why their team member dropped out the project, "*I don't know why she dropped out the training, but I think she could be too busy at school and family to continue the project.*"

The national policy for primary and junior high education is to advocate the campaign of the educational reformation, "Nine-Grade Joint Curricula," by launching a series of teachers' on-job training plans including applying IT to subject teaching.  Furthermore, the teachers' on-job trainings were more product-oriented, but it's a pity that the educational authorities didn't provide sufficient resources and incentive systems to promote this type of on-job training.

#### 4.1.2  Organizational context

The participants of this project came from 19 different primary schools, and we portray these schools in an organizational perspective including organization size, culture, senior management support, and IT infrastructure.  Although teachers are encouraged to form "class groups" to cooperate with colleagues, the cooperative culture is actually unpopular among the schools from which the six teams' members came.  Computer facilities were available in classrooms and administration offices, and it was convenient for teachers to surf Internet at schools.  School Principals supported IT related activities, but IT resources for teachers to use in class teaching were usually insufficient.

#### 4.1.3  Group context

Six major group contextual factors are group size, group composition, group structure, cohesiveness, leadership, and project topic.  The number of each team members was originally five in average assigned by the training project manager.  Through the project execution, the team participants for team A to E are 6, 7, 3, 3, 4, and 5 because of members' turnover spontaneously.  The group size affected the interaction of team members.  For example, a member of Team D said, "*We have to work harder because our team has remained only three persons; otherwise, how could we accomplish the training?*"  Furthermore, the leader of Team C also described the situation, "*Our ideas are few because we have only three members.*"

Each team was composed of certified and trainee teachers, and might be major at

teaching subjects or IT. Therefore, participants were anticipated to cooperate complementarily via the division of professional efforts. For instance, a member of Team E described their team cooperation, *"I am not good at IT, but fortunately, some of our members specialize in IT. So, we can cooperate complementarily."*

We induced group roles (Berne and Sheats, 1948; Vander Kolk, 1985) and knowledge creation roles from the team interaction, and then analyze the status of the team members. Generally, the information/option seekers, givers, and recorders existed in teams. There were gatekeepers and several silent members in Team B and E. A monopolist who disseminated negative thoughts about this on-job training and wasn't active to participate in Team A. Team B and D distinguish themselves from other teams by leaders acting as initiators, guiders, and encouragers.

In the process of inter-organizational knowledge sharing and creation, we induce several knowledge creation roles, such as knowledge contributors, idea generators, integrators, task performers, information providers, and followers. The major roles of each team are information providers, idea generators, integrators, and task performers. However, members of Team A are recognized as idea providers, the team performance was bad due to lack of task performers. This phenomenon can be explained by the "swift" trust defined by Meyerson et al. (1996). The lack of action and initiative of Team A resulted in decreasing trust, and in turn, degenerate team performance.

The status hierarchy of the team is not salient except for Team B, which the members regard their leader as an expert at using IT in teaching. Most of Team B members asked for the leader's opinion before taking action, so members had the dependent mentality toward the leader. Senior teachers were not necessary to possess higher status in the team. For example, Team B had two senior teachers experienced at teaching science; however, other members did not regard them as key members because their low participation in the team task.

Three concepts, *morale, group attraction*, and *coordination efforts*, are usually used to describe cohesiveness (Shaw, 1981). We induce two additional concepts of cohesiveness: *commitment* and *attendance.* Morale is the level of motivation evidenced by group members (Shaw, 1981), and commitment is that group members are willing to try their best to reach the common group goal. Team C and D, whose members had close personal ties due to small group size, had higher level of morale and commitment to the team. Team B and F had relatively medium level of morale and commitment. Team A and E had the lowest level of morale and commitment because the members thought the task just needed one or two persons to accomplish, and moreover, Team E had a mainstay.

Group attraction includes resistance to leaving the group and thus can be evaluated by the turnover (Shaw, 1981). Team A had the highest turnover, and the members of Team F were fixed from the start to the end. Group attraction affected the team performance. For instance, the leader of Team A said: *"Because our team members were not fixed, we didn't take action until passing half of the project time."* All Team A's members were free riders, and no one initiated before half the project time, and didn't take action until the project was about to end. Moreover, someone disseminated negative thoughts about the training in Team A, and the coordination efforts were very high. Other teams had relatively lower level coordination efforts. Attendance is also considered an evaluation of cohesiveness (Johnson and Johnson, 1991). Team D had good attendance on each meeting.

We induce two concepts of leadership: the source of power and leadership styles (Lewin, Lippitt and White, 1939). The source of power of Team B leader was expert power because members regarded her as an expert. Furthermore, the power of Team C leader was also expert power, and he ever said:

*"Other two members are trainee teachers (I am the only certificated teacher), and that's*

*why they elected me as the leader."*

Team A leader's leadership style is Laissez-faire style (Lewin, Lippitt and White, 1939) because no one worked before half the time, but he did not initiate the teamwork and even imputed their poor product to the high turnover. Others' were democratic style but no autocratic style (Lewin, Lippitt and White, 1939).

### 4.1.4  Individual context

In general, primary school teachers who participated in the seven-week on-job training project had high motivation to improve their ability of adopting IT to teaching. The participants are depicted by several sub-categories. They are professional level, time spent on this project, habit of using IT, characteristics, habit of cooperation, experiences of sharing, IT capability, consciousness of IT affecting teaching ability, motivation, expectation to this project, perception of this project, and perception of SCTNet.

The professional level was measured by years of teaching, certificated/ trainee teacher, and the perception of professional role. On the whole, whether members were certificated or not, their professional perception was high, and most of the participants' professional level was above medium level.

Teachers spent less time on this project than expected, because the average loading of primary school teachers was heavy in general. For instance, most of Team E's members were administrators and class teachers simultaneously. In addition, their high priorities of daily schedule was to search for teaching materials on the Internet and to prepare for teaching, so that little leisure time was reserved.

Their habits of using IT are very similar. They spent one to two hours on surfing Internet, four to six days a week. Due to the time pressure at schools, they usually dialed up at homes. All of them had their own e-mail accounts and checked mails every two days in average, but did not have the habit to respond mail immediately. They logged on the SCTNet half to one hour every day, and four to six days a week.

Their experiences in sharing and collaborating with other colleagues were few. The majority of participants viewed themselves with low IT self-efficacy in terms of computer efficacy and using IT for teaching. No wonder that most of participants expected to gain IT skills, and unmatched with the expectation of the product-oriented training project. To react to this mismatching, Team A resisted to adjust themselves to actively follow the training agenda.

### 4.1.5  Project context

The project context was codified by the task type, team-up rule, autonomy, agenda, warm-up time, geographical distance, and professionals' intervention. It was an explorative task granting high autonomy for participants to search for any possibilities to develop lesson plans via collaborative team work with teachers from different primary schools. They were allowed to communicate through either SCTNet's SIG or face-to-face meeting (at least one meeting per week). Due to time restriction, project teams had few time to warm up.

### 4.1.6  IT context

We induced two concepts of IT context: SIG and website orientation. Because the place of the on-job training in distance was far away from participants' schools, SCTNet allowed them to communicate and to share their experiences, knowledge, and opinions. SCTNet provides many functions of group memory, such as electronic bulletin boards, SIGs, e-mails, resources sharing, website recommendation, message boards.

### 4.2 Causal Conditions

Several factors identified are significantly different in adopting strategies, and in turn resulting in different consequences for inter-organizational knowledge sharing and creation. We induced these causal conditions in two levels: *individual level* (enthusiasm, intention to share, adjustment to training process, consciousness of IT affecting teaching ability), and *group level* (group roles, knowledge creation roles, morale, commitment, and leadership styles).

Team members who possess high level of enthusiasm and intention to share demonstrated high enthusiastic group roles and knowledge creation roles. Thus, the consequence is superior than that generated from teams having lower level enthusiasm and intention to share. In addition, higher level of morale and commitment of the team also had positive impact on the outcomes because they fostered members' interaction to reach the consensus quickly. Here we enumerate two extremely different examples of teams, Team A (inferior performance) and B (superior performance) to illustrate the causal relationships as shown in Table 1.

**Table 1. Comparison between Team A (inferior performance) and Team B (superior performance)**

| | | Team A | Team B |
|---|---|---|---|
| **Individual Level** | Enthusiasm Intention to share | • Lack of enthusiastic members<br>• Not everyone is willing to share their own information<br>• One didn't share anything until others shared | • The leader has great enthusiasm<br>• The leader's intention to share is very strong<br>• The two senior teachers are more passive to share |
| | Adjustment of expectation | • They didn't adjust themselves to the on-job training and complained that they didn't learn the applications of IT in teaching | • Perhaps the on-job training fell short of someone's original expectation, but they can adjust themselves to the training and regard it as a kind of learning |
| | Consciousness of IT affecting teaching ability | • Low | • High |
| **Group Level** | Group roles | • Information/option seekers or givers<br>• A recorder<br>• A monopolist | • An initiator, an orienter and an encourager (the leader)<br>• An gatekeeper<br>• Information/option seekers or givers<br>• Several followers and silent members |
| | Knowledge creation roles | • The majority were idea providers | • The majority were task performers<br>• The next were idea providers and integrators |
| | Morale | • Low level of motivation evidenced by group members<br>• High level of anxiety about the goal of the training | • Relatively medium level of motivation evidenced by most group members |
| | Commitment | • Low level of commitment to the team<br>• They thought it just needed one or two members to accomplish | • Relatively medium level of commitment to the team<br>• Two senior teachers was more unconcerned |
| | Leadership styles | • Laissez-faire style | • Democratic style<br>• Other members didn't take action until the leader instructed |

*4.3 Action/Interaction Strategies*

Action/ interaction strategies can be classified into three sub-categories: *collaboration strategies, using IT strategies,* and *knowledge sharing and creation strategies*. The definitions of the three strategies are shown in Table 2 to 4. They are derived from the information logged on the SCTNet, face-to-face meetings, and the interviews by phone. Furthermore, according to the group roles (Berne and Sheats, 1948; Vander Kolk, 1985), we classify the concepts of collaboration strategies. In addition, Figure 2 depicts the interaction process of each team, and thus, we can easily identify the frequency of teams' interactions.

**Table 2. Collaboration strategies**

| Group roles | Description |
| --- | --- |
| Initiator | Stimulate the group, and provide new ideas or thought. |
| Information/ Option seeker | Seek information or option from the group for individuals to make judgments. |
| Information/ Option provider | Provide information or option. |
| Guider | Instruct the group correct goals and direction. |
| Evaluator | Describe the task accomplished, and evaluate the outcomes. |
| Recorder | Recording resolutions and plans |
| Encourager | Accept members' options by praising, agreeing, or stimulating |
| Gatekeeper | Oversee and establish the group norm, usually demonstrate themselves |
| Follower | Follow instructions to perform tasks when the group needs |

**Table 3. Using IT strategies**

| Strategies | Definition | Examples |
| --- | --- | --- |
| Acknowledgement | Transfer confirmation message | Acknowledgement of documents reception. |
| Emotional expression | Interflows of emotional expressions between members. | Encouragement, or emotional expression. |
| House keeping | Inform messages needed for better coordination | Liaison affairs, scheduling, and meeting logs. |
| Information exchange | Share information or experiences with members. | Upload files, task-related resources, and recommendation. |
| Idea release | Propose ideas or suggestions toward some topics. | Suggest some alternatives, and share viewpoints |
| Creative revision | Integrating knowledge, documents or experiences into new knowledge objects. | Combination of knowledge. |

**Table 4. Inter-organizational knowledge sharing and creation strategies**

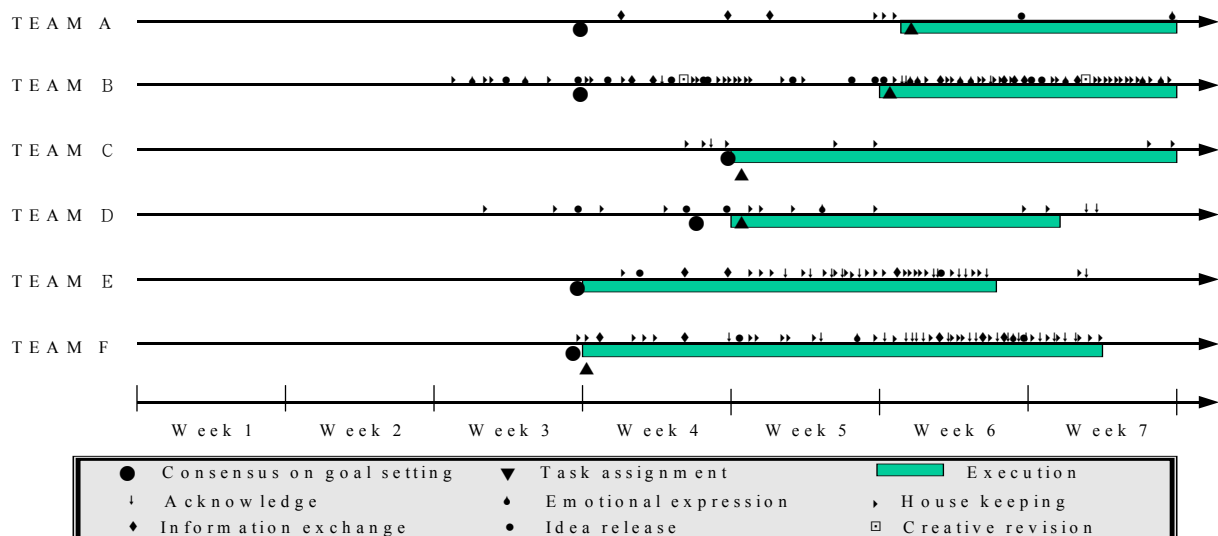| Strategies | Description |
| --- | --- |
| Knowledge Contributing | Contribute domain knowledge. |
| Idea Providing | Provide ideas. |
| Knowledge/ Ideas Integrating | Combine knowledge/ ideas of members. |
| Task Performing | Perform task. |
| Following | Not to take action until instructed. |

**Figure 2. Team interaction process**

### 4.4 Consequences

The consequence of collaborative lesson plan development via inter-organizational knowledge sharing and creation is categorized at three levels: *individual, group,* and *organizational levels.* Two major concepts of individual level consequences are *self-efficacy of using IT in teaching* and *professional social network enlargement.* The self-efficacy is measured by individual perspective in understanding IT in teaching and capable of using IT in teaching, and the results are summarized in Table 5. Of these measurements, the self-efficacy of using IT in teaching was low in average among the six teams because their original expectation fell very short to the on-job training that didn't teach lots of IT skills. A member of Team A said, "*The greatest gain is that I have known several friends after this on-job training.*" A member of Team B also said, "*I obtained a lot of ideas from other teachers from different schools.*" A member of Team E mentioned, "*We are not lonely on the road of education, and there are lots of valuable resources to share and help us to interact with one another.*"

Product and goal attainments are two dimensions of group level consequences. Since the training focused on the collaborative process of innovating lesson plans, the team product was measured in terms of novelty, degree of combination, and feasibility. To prevent subjective bias, three experts evaluated the product of each team.

**Table 5. Consequences: group performance**

|  | Team A | Team B | Team C | Team D | Team E | Team F |
|---|---|---|---|---|---|---|
| Self-efficacy | 6.47 | 7.93 | 6.76 | 7.00 | 9.25 | 8.56 |
| Product | 3.11 | 7.78 | 6.11 | 6.11 | 4.89 | 5.44 |
| Goal attainment | 8.50 | 8.30 | 9.20 | 7.50 | 8.40 | 8.80 |

### 4.5 Theoretical Findings

Through axial and selective coding, we distill main theoretical findings to explain our wonders in low degree of using IT during inter-organizational knowledge sharing and creation in the teacher professional community. The findings are listed as follows:

1. **The perception of using SCTNet affects the frequency of on-line interaction.**

As shown in Figure 2, Team B, E, and F had much more frequent team interaction than Team A, C, and D.   We compared the results with the perception of using SCTNet in terms of perceived ease of use and perceived usefulness shown in Table 6, and found that the perception of using SCTNet had positive correlation with team interaction frequency. This relationship confirms TAM in explaining that the perception of communication media affects the user choice of communication media.   The findings are summarized as the first proposition, $P_1$: *The perception of communication media affects the frequency of on-line interaction.*

**Table 6. The perception of using SCTNet**

|  | **Team A** | **Team B** | **Team C** | **Team D** | **Team E** | **Team F** |
|---|---|---|---|---|---|---|
| **Perceived ease of use** | Low (0.17) | Medium (0.60) | Low (0.33) | Extremely Low (-0.33) | High (1.00) | High (1.20) |
| **Perceived usefulness** | Low (0.67) | Medium (1.20) | Medium (1.00) | Low (0.67) | High (1.33) | Medium (1.20) |

2. **The frequent team interaction contributes to high individual self-efficacy in using IT for teaching.**
   Figure 3 presents that high individual self-efficacy obtained after the training project at Team B, E, and F.   This result is coherent with the high frequency of team interaction through SIG's facilitation.   Because of the time limitation of this training project, frequent interaction between team members facilitated the collaboration to develop lesson plans.   This leads to the second proposition, $P_2$: *The frequent team interaction contributes to high individual self-efficacy in using IT for teaching.*
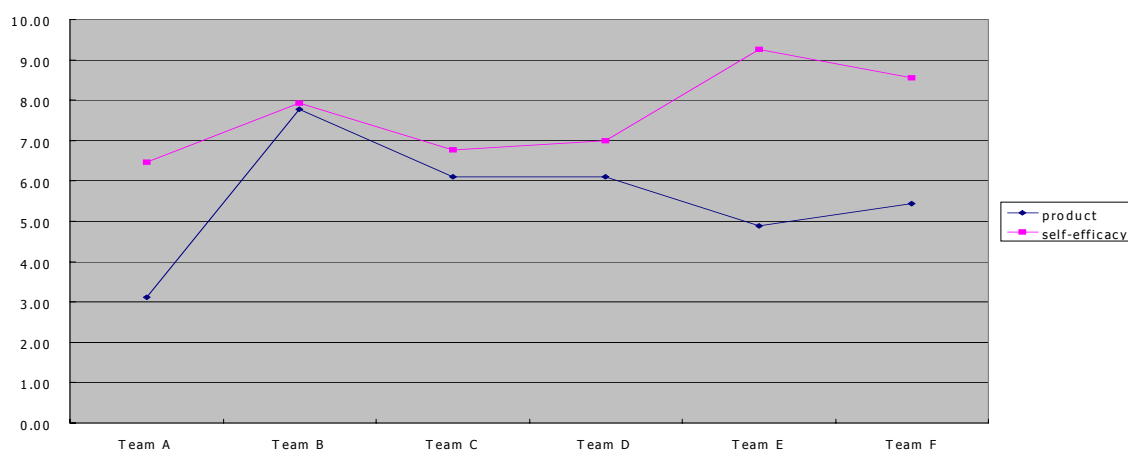


**Figure 3.    The comparison of team product and individual self-efficacy**

3.   **The process of group interaction significantly affects the individual use of IT.**
   It is worthy to note that the perception of using SCTNet shown in Table 6 resided in the group context which individuals are gathered.   The group norms guided action, and were established by the interaction of group members to maintain behavioral consistency, and to reduce the ambiguity, which members feel intolerable (Shaw, 1981).   During the course of the group interaction, the norm of using IT was established, and then members followed this rule.   From the causal conditions of the group level, such as commitment, leadership, morale, group roles, and knowledge creation roles, significantly affected group members' attention to use IT.   For instance, Team F resulted in consensus of using SIG's functions to communicate, and the leader said:

> *"In the beginning of the training, the professor and instructors introduced SCTNet and its advantages for remote cooperation, so that my team members and I cannot wait trying the new communication means…"*

Extended from the first proposition, the third proposition can be formulated as follows, *P₃: the process of group interaction significantly affects the individual use of IT.*

4. **The causal conditions from individual and group contexts significantly affect the team performance, but not from organizational context.**

   According to the difference between product and self-efficacy in Figure 3, we can classify teams into three clusters: (1) small (Team B), (2) medium (Team C and D), and (3) large (Team A, E, and F). What are factors that make the differences and affect the team performance of the inter-organizational knowledge sharing and creation? From the theoretical model of inter-organizational knowledge sharing and creation the research proposed, the causal condition consists of two contexts: *individual* context (enthusiasm, intention to share, consciousness of IT affecting teaching ability, and adjustment to training process) and *group* context (group roles, knowledge creation roles. morale, commitment, leadership styles), but none are from the organizational context. Thus we conclude the fourth proposition, *P₄: The causal conditions in individual and group contexts significantly affect the team performance, but not in the organizational context.*

5. **Inter-organizational knowledge sharing and creation through web-based group support system is restricted by media richness.**

   The place of on-job training in distance was far away from the schools the participants worked; however, it provided participants with high autonomy allowing them to make a choice of using various means of communication, such as SCTNet, e-mails, face-to-face meetings, or telephones. However, most teams chose face-to-face meeting, in which idea release and creative revision occurred. They preferred face-to-face meetings to other communication media. For instance, Team F adopted face-to-face meeting to discuss their project details, and the leader said,

   > *"Perhaps teachers' (members') habit of using IT is still insufficient to communicate only by IT, and using e-mail to contact is uneasy. So that we finally still met face-to-face to discuss, and used e-mail to exchange the information."*

   Furthermore, the leader of Team A said,

   > *"I think face-to-face will not and cannot be replaced by IT. I cannot tell which is better, but I think both of them should complement each other. Face-to-face possess a kind of climate which can encourage us to generate ideas, and this is why Internet cannot replace face-to-face communications."*

   We further analyzed the IT using strategies of these teams, and found that teams used SIG's functions mainly for housing keeping (e.g., scheduling, meeting logs, and liaison affairs), and acknowledgement (confirmation of message transferred or documents received). Deep interactions, such as idea release and creative revision, are very few through the provided IT platform. We conclude the fifth proposition, *P₅: Inter-organizational knowledge sharing and creation through web-based group support system is restricted by media richness.*

## 5. Discussion

Several research results are worthy of further discussion. First, the finding confirms TAM at the individual level that positive perception of communication media results in frequent on-line interaction. The individual enthusiasm, intention to share, consciousness of IT affecting teaching ability, and self-adjustment to the group work are antecedents of subjective norms to influence on-line interaction via groupware, such as SIG's functions on the SCTNet.

Based on network externality, Lou, Lou, and Strong advanced groupware acceptance model that incorporates perceived critical mass as an independent variable for predicting groupware acceptance (2000). Their finding indicates that a user's decision to use groupware is influenced by whether or not the same technology is used by their peers in the group. Furthermore, from causal condition identified from this research, group influences, such as morale, commitment, group roles, knowledge creation roles, and leadership styles, play important roles in facilitating on-line interaction. These factors directly affect team members on choosing groupware, and indirectly reach the critical mass of using the groupware.

Second, the results show that group performance is highly influenced by several factors from individual and group contexts, but not from the organizational context. There are two possible causes. One is that the organizational structure and culture of primary schools in Taiwan are similar because teachers came from similar training institutes and performing similar tasks. The other may be that lesson plans designed during the training project have not been applied at class where the physical environment may contribute the variations. Thus, organizational context can be hypothesized irrelevant or cast unapparent influence on performance of inter-organizational knowledge sharing and creation for teachers at primary schools.

Third, the effectiveness of inter-organizational learning through team collaboration on CSCW systems, such as SIG on the SCTNet, should take media richness theory into consideration. From the results, participants were willing to spend at least one hour driving to meet face-to-face to generate, combine, and revise ideas rather than through the on-line discussion vehicles. According to McGrath and Hollingshead's task-media fit matrix (1993), performing creative or intellective task such as ideas or plans generation groups should adopt computer communication in order to achieve good fit state. Face-to-face channel, on the opposite side, provides too rich information to achieve poor fit state. Our research results are not aligned with their arguments in task-media fit hypothesis. Further investigation is needed in the future to dig out the suitable media richness for group knowledge creation in the teacher professional community.

## 6. Implications for Research and Practice

This research portrayed the inter-organizational learning model through team collaboration on the web-based cyber community system, SCTNet. Following the coding procedure of the grounded theory approach, we identify contextual factors influencing the team interaction and performance. Five propositions are proposed through selective coding to specify the significant relationship among contexts, conditions, strategies, and consequences. The research results shed light on the development of teacher cyber communities for professional improvement.

For research, the framework of inter-organizational learning facilitated by team collaboration is a socio-technical model. The factors identified from individual, group, organizational, IT, and project constructed the primitive propositions, and further thoroughly empirical studies can be applied to verify these concepts and categories discovered from the grounded theory approach. For practice, the know-how obtained from teacher professional communities may be applied to other professional communities after further validation.

## Acknowledgement

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