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## 子計畫一：網路合作設計學習模式之研究(3/3)

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## 子計畫一：網路合作設計學習模式之研究(3/3)

### 中文摘要

本研究認為為了維持良性的合作學習品質，必須將學習任務的類型納入課程設計的範疇。故參考 Steiner 對學習任務性質上的四種分類，於網路中介模擬環境 MUD 中設計教學活動，並以 Milson 的團體工作溝通模式為依歸來評估小組合作互動模式，探討任務類型對引導良性合作學習的影響。另一方面，也嘗試設計使用互動頻率值，來捕捉互動頻率與小組合作互動模式之間的關聯性。

我們以北部兩所高商資料處理科一年級學生作為實驗對象。實驗結果發現，連結式的任務能引導出較多良性的小組合作互動模式，因此適合施行於網路合作學習課程中。此外也發現，小組成員間互動的頻率與他們的合作互動模式存在顯著關聯，可作為評估小組合作互動模式時的一項可靠指標。

關鍵詞：合作學習、網路中介模擬、學習任務類型、小組合作互動模式

# **Impacts of Tasks on Promoting Positive Cooperative Learning in Internet-mediated Simulation Environments**

## **Abstract**

To induce positive cooperative learning experiences, it is necessary to consider task classification when designing a course. The authors use an instructional experiment conducted within an Internet-mediated simulation environment to identify the impacts of task type on promoting positive cooperative learning. We relied on Steiner's task classifications and Milson's small-group interaction/communication patterns when designing our experiment, and attempted to capture the relationship between interaction frequency and small-group interaction patterns. Participants were freshmen in the data processing departments of two vocational schools. Experimental results suggest that conjunctive tasks are better suited to promoting positive small-group interactions in Internet-based cooperative learning courses. Furthermore, a statistically significant relationship was noted between interaction frequencies and interaction patterns.

## **Introduction**

Cooperative learning has entered the mainstream of educational practices for two reasons: a) the growing amount of research showing that it increases student achievement (Chambers & Abrami, 1991), outcomes associated with improved inter-group relations (Weigel, Wisner & Cook, 1975), and self-respect (Blaney, Stephan, Rosenfield, Aronson, & Sikes, 1977); and b) the growing realization that students must learn skills that allow them to integrate and apply knowledge in order to solve problems (see also Slavin, 1995).

More recently, researchers and educators have been searching for ways to combine cooperative learning techniques with both online and offline computer environments. Iren Greif and Paul Cashman (1984) are considered innovators in this area. The primary goal of the Computer Support Collaborative Work (CSCW) they developed in 1984 was to use computers to help individuals communicate with each other for problem solving purposes. Computer Support Collaborative Learning (CSCL) —considered a combination of CSCW and education— emphasizes the recording of user behaviors so that instructors in cooperative learning environments can use the data for observation and evaluation.

To be successful, cooperative learning must go beyond bringing students together—with or without computers and the Internet—to study or solve problems. Ideally, students perform learning activities in small groups and receive rewards or recognition based on group performance (Slavin, 1980). Individual members are expected to make intellectual contributions, obtain and share knowledge about a task, and practice social skills when assisting each other. Positive cooperation can help students gain knowledge that transcends the original assignment.

Johnson & Johnson (1987) suggested that a central element of cooperative learning is promotive interaction, since the absence of interactive behavior means that students cannot benefit from the resources of other members in their group or from establishing social connections. Unfortunately, a large number of teachers still focus on the end results of cooperative projects rather than on the interactive processes through which goals are achieved. They therefore overlook both positive and negative acts of cooperation.

When proposing a model for measuring a group's maximum possible level of productivity, Steiner (1972) emphasized member resources and task demands. Those resources included all

relevant knowledge, abilities, skills, and tools possessed by the individual(s) performing the task. He argued that the relevance of a particular resource to a group was task-dependent. Accordingly, they need to be considered when designing cooperative learning curriculums and activities.

Steiner (*ibid.*) also established a classification system that takes into account how task demands link individual resources to potential group productivity. He identified the four primary unitary task types as additive, conjunctive, disjunctive, and discretionary. In additive tasks, group products equal the sum of group member contributions. In conjunctive tasks, group productivity is equal to that of the least capable member. In disjunctive tasks, a group must select one answer or contribution from a single member. In discretionary tasks, group members are allowed to combine individual inputs in any manner they choose.

Until recently, most research on cooperative learning focused on the relationship between group productivity and such factors as gender and ability (Dalton et al., 1989), race (Oetzel, 1998), learning styles (Huxham & Land, 2000), and motivation (Carrier & Sales, 1987). However, another group of researchers has focused on how task types dominate the outcomes of cooperative learning because of their effects on member resources—a challenging topic because of the variation involved. Understanding the impacts of tasks on cooperative learning processes can help teachers choose appropriate Web-based courses for their students, and assist today's researchers in their efforts to identify those factors that lead to increased group productivity (Cohen, 1994).

To determine which task types are better suited to cooperative learning in Internet-based courses, we analyzed data from an experiment involving the four task types described by Steiner. Specifically, we used an Internet-based Multi User Dungeon (MUD) to simulate

scenarios requiring cooperation by participants. Unlike most Web-based platforms that are only capable of recording intra-group text-based conversations, MUDs can be used to record emotional content and, to a certain degree, the motivations behind individual actions. This allows researchers and educators to perform more detailed analyses of cooperative group processes.

The main reason for using Internet-mediated simulations is to provide virtual spaces for observable participant interactions. MUDs—commonly referred to as multi-user online games—are perhaps the best-known examples of these simulation programs. A long list of researchers have used them and similar simulation platforms to investigate how certain factors (e.g., role identification, role playing, and social interaction) influence social functions (Rheingold, 1993; Turkle, 1999). Others have studied the roles and actions of MUD administrators (Suler, 1996) and the social values and norms that are embedded in simulation environments (Reid, 1999; Zdenek & Sean, 1999).

The MUD that we constructed for this research belongs to the category of learning MUDs, in which environments are viewed as knowledge metaphors (Hsieh & Sun, 2004). With the features of anonymity, parallel communication, and group memory (Nunamaker et al., 1991), these types of MUDs can reduce unfavorable statements in classrooms and increase the number of opportunities for positive communication and for practicing collaborative and higher-level analytical skills.

### **Small-group Interaction Patterns**

Group interaction processes help decide the positive or negative character of cooperative results. Cohen (1994) has argued that group interaction is the most important determinant of productivity. Chen et al. (2003) recently confirmed that intra-group communication patterns

exert a significant effect on group performance. However, there is a large number of interaction types and methods that can lead to a variety of achievements—some beneficial, others detrimental (Webb, 1982). Teachers need to encourage positive intra-group interactions, otherwise cooperative processes can easily lose their intended effects.

Morgan et al. (1993) described two tracks of group processes: a) a taskwork track that accounts for activities considered unique to the task and that influences how well a group performs a particular task; and b) a teamwork track that encompasses skills related to interpersonal interactions that influence the effectiveness of individual group members. These skills include adaptability, communication, coordination, decision making, and leadership (O'Neil et al., 1997). Our goal in this study was investigate the impact of tasks on positive cooperative learning by evaluating the ways that individual group members interact.

To represent intra-group communication, we relied on Milson's (1973) communication patterns. We took all possible interactive links among three members into consideration in order to illustrate the small-group interaction patterns shown in Figure 1. In that figure, links represent oral, emotional, or physical communications. Ideal and dominant leaders are defined as positive examples, since they reflect the features of cooperative learning more completely than other patterns. In Figure 1, the interactional links are defined as

1. Ideal (three bidirectional links). Three group members interact via multiple communication routes.
2. Dominant leader, with individual bidirectional links connecting three group members.
3. Cliquish, with one bidirectional link between two group members, thus putting the third member in a position of isolation.
4. Unresponsive, with only one unidirectional link. A group member may try to communicate, but the other two fail to respond.

5. Unsocial, with zero links. Group members simply do not communicate.

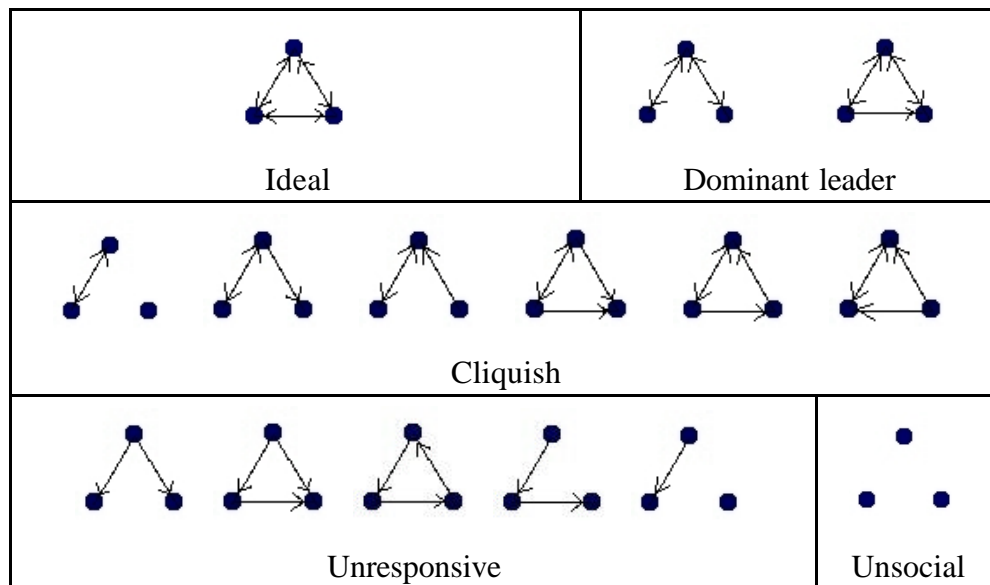


Figure 1. Small-group interaction patterns.

### Methodology

Controlling group formation is important for maintaining quality cooperation and avoiding the negative impacts of certain member resources. Past researchers have found that a) the best group size for cooperative learning is 3-4, and b) members with lower abilities get more when they belong to heterogeneous groups (Lou, Abrami, Spence, Poulsen, Chambers, & d'Apollonia, 1996). For this study, we used midterm examination grades to create 18 heterogeneous groups of programming language students consisting of one high, one medium, and one low score. Each group was assigned a cooperative activity belonging to one of the four task classifications described above.

When designing communication commands and learning activities, we followed the principle of creating an environment that facilitated positive cooperative learning. In terms of evaluating levels of group cooperation, we used the small-group interaction patterns defined



in a previous section when inspecting interactive records. In addition, we defined an index—interaction frequency—to evaluate the amount of interaction that one group member participated in with the other two. This index was also used to identify the small-group interaction patterns shown in Figure 1.

#### *Analytic Method for Interaction Patterns*

After considering the MUD environment and activities, our analytical focuses were a) question communication and b) goal coordination. Each group expressed interaction patterns in these two areas. Observing question communication, which entails adaptability and communication as parts of O'Neil et al.'s (1997) teamwork track, entails identifying queries and responses regarding programming language, environment, and system operation. Goal coordination involves organizing actions for completing tasks on time; in the MUD created for this study, this includes queries and responses for finding and exchanging coins or treasure, sharing coins, and verbal interactions required for making quick decisions. Groups that executed a discretionary task (i.e., writing an essay as a learning activity) expressed a third interaction pattern. The essay writing task, was viewed as a part of the teamwork track, with decision making and leadership skills required to direct discussion and organize suggestions into a coherent essay.

To evaluate group interaction patterns, we relied on input from three experts—one of the authors and two doctoral students from the Computer and Information Science department at National Chiao Tung University. When there is a conflict between any two of the experts, the pattern evaluated twice is selected since small-group interaction patterns are not numeral data type and we can't decide a group's result by computing the average. Furthermore we need to check whether three experts' evaluations are significant related or not. If they are then the method of choosing interaction patterns with the most amounts can be used.

### Interaction Frequency Analysis

We assumed that interaction frequency would increase in the presence of positive member actions, emotions, and conversations and decrease in the presence of negative actions and emotions. Interaction frequency thus represents not only oral communication frequency, but also emotion- and action-based interactive frequency.

A directional link between two members of the same group was labeled as successful when the interaction frequency was higher than the value calculated as the interaction frequency average minus one-half the standard deviation. The threshold for determining successful links—termed the *lowest interaction frequency*—was used as another small-group interaction pattern. We had no standard to use for deciding whether an identified lowest interaction frequency was too high or too low. We nevertheless attempted to find a potential relationship between interaction frequency and interaction patterns outside of communication content.

Figure 2 presents an example of how to identify small-group interaction patterns from the interaction frequency of each group member working on a conjunctive task. The lowest interaction frequency score was computed as 170, meaning that the interaction frequency of any successful link between two group members needed to be greater than 170. In Figure 1 there are two successful bidirectional links—one between members A and B and the other between members B and C; this is an example of a dominant leader interaction pattern.

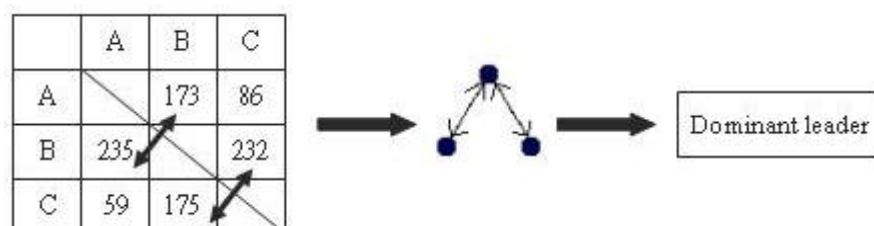


Figure 2. Using interaction frequency to find small-group interaction patterns—an example.

## Experiment and Results

Participants were 216 freshman students in the Data Processing departments of two commercial vocational high schools in the north area of Taiwan. The two-hour learning activity, named “Exploring Taiwan by Train,” was designed to teach the programming language concept of “for-loop.” The main railroad lines serve as a metaphor for outside loops and the branch lines as a metaphor for inner loops. The control condition is the number of tickets purchased. A sketch of the experimental environment is shown in Figure 3. The upper part of the environment consists of a railroad map in which each grid represents a train station. The lower part of the environment is a description of the station (or nearby area) and task instructions. Task types and goals are listed in Table 1.

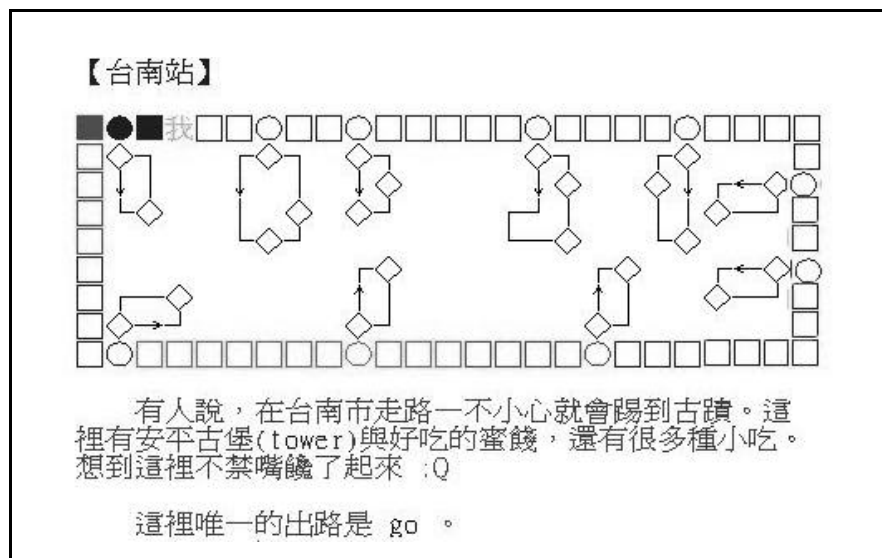


Figure 3. Taiwan railroad exploration environment.

Table 1. Task classification and corresponding goals.

Task Classification	Task Goal
Additive	Group with most total treasure wins.
Conjunctive	Group whose members each collect an amount of treasure = 5 wins.
Disjunctive	Group with an individual member who has the most treasure wins.
Discretionary	Use the names of parts of the gathered treasure to write an essay.

Unlike coins, treasure could not be given to others or exchanged for any reason. Accordingly, treasure was viewed as an individual learning goal and coins as resources and conditions for achieving a goal. Another reason for denying the ability to share treasure is that it stopped group members from “paying” others to do their work and encouraged them instead to use resources for collaborative purposes.

#### *Task Impacts on Small-group Interaction Patterns*

We performed Kappa coincidence tests for the three sets of evaluations prior to analyzing the impacts of the various tasks on small-group interaction patterns. The results from these tests show high levels of coincidence among the three evaluators at statistically significant levels (Table 2).

We used a Chi-square test to examine relationships between task classifications and small-group interaction patterns. According to the cross table presented in Table 3, target interaction patterns (Ideal and dominant leader interaction patterns) were most evident among groups working on conjunctive tasks, followed by unsocial patterns in groups working on disjunctive tasks. The simple main effort should be test for each row and column.

Chi-square test results for task classification and small-group interaction patterns are presented in Table 4. According to the data, statistically significant differences were noted for the effect of a) conjunctive tasks on question communication, b) conjunctive tasks on goal coordination, and c) ideal interaction pattern. Compared to other task types, groups working on conjunctive tasks were the most likely to show ideal interaction patterns on question communication. In addition, a higher number of conjunctive task groups showed dominant leader patterns in terms of goal coordination compared to other task groups. In other words, the data indicate a greater likelihood of positive interaction patterns among groups working on

conjunctive tasks.

Table 2. Results from Kappa analyses of the three experts' evaluations.

	Kappa*
Expert 1 × Expert 2	.829
Expert 2 × Expert 3	.497
Expert 3 × Expert 1	.602

\*  $p < .001$

Table 3. Task classification and small-group interaction patterns.

Interaction Pattern Task Classification	Ideal	Dominant Leader	Cliquish	Unresponsive	Unsocial
Additive task on question communication	6	2	4	2	4
Additive task on goal coordination	0	5	5	1	7
Conjunctive task on question communication	10	5	2	1	0
Conjunctive task on goal coordination	1	10	5	2	0
Disjunctive task on question communication	2	4	4	3	5
Disjunctive task on goal coordination	0	2	2	5	9
Discretionary task on question communication	3	5	5	4	1
Discretionary task on goal coordination	1	7	4	3	3
Discretionary task on essay writing	1	3	2	8	4

Table 4. Chi-square test results for task classification and small-group interaction patterns.

	Chi-square
Task classification × interaction patterns	80.612*
Conjunctive task on question communication	10.889**
Conjunctive task on goal coordination	10.889**
Ideal for interaction patterns	20.333***

\*  $p < .001$ ; \*\*  $p < .05$ ; \*\*\*  $p < .01$ .

#### *Relationship between Interaction Frequency and Small-group Interaction Patterns*

We also computed the lowest interaction frequency for each task type and used the results to identify interaction patterns, once again using the Kappa coincident coefficient data to compare interaction pattern frequencies as evaluated by the three experts. The results presented in Table 5 show a statistically significant relationship between interaction frequency and interaction patterns, with question communication showing greater significance than goal coordination. Although interaction frequency did not completely match actual interaction patterns, it did reach a level of statistical significance.

Table 5. Kappa analysis of interaction frequencies and actual interaction patterns.

	Kappa
Interaction frequency × actual interaction pattern on question communication	.269*
Interaction frequency × actual interaction pattern on goal coordination	.125**

\*  $p < .01$ ; \*\*  $p < .05$ .

#### *Statistical Results for Questionnaires*

All participating students were asked to fill out a questionnaire designed to elicit data on how they felt about the learning activity. The results indicate that 60 percent had a favorable impression and agreed with a statement that the activity was helpful to their learning. More

than half stated that they liked the MUD environment and wished that similar kinds of simulation environments could be used in their general courses.

## **Conclusion**

From our experiment, we found that the conjunctive task produced the greatest amount of ideal interaction within groups in terms of question communication, and conjunctive task has more number of dominant leader on goal coordination than that of other patterns. We therefore suggest that conjunctive tasks are better suited than the other three task types for promoting positive cooperative learning in Internet-mediated simulation environments.

There are two possible reasons for this finding. First, conjunctive tasks are better suited to encouraging positive interdependence—that is, for promoting intra-group interaction and resource exchange to achieve a goal. It is because they know that one can not success unless all of them success. Second, an emphasis on individual group member productivities (instead of the result turned in by the entire group) in conjunctive task evaluations may encourage communication, sharing, and providing mutual assistance.

We also noted that there are statistically significant relationships between interaction frequencies and actual interaction patterns. It may be because that positive cooperation needs more interaction. Members who belong to ideal interaction pattern would spend more time communicating while members who belong to unsocial interaction pattern did not.

The findings confirm the relationship between task classification and positive cooperative learning, and support the use of conjunctive tasks for promoting positive cooperative learning in Internet-mediated simulation environments. We therefore suggest that the relationship

between interaction frequencies and interaction patterns is a worthy candidate for use as an index for evaluating small-group interactions in Internet-mediated simulation environments.

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