Effects of Anonymity in Group Discussion on Peer Interaction and Learning Achievement

Bin-Shyan Jong, Chien-Hung Lai, Yen-Teh Hsia, and Tsong-Wuu Lin

Abstract—When students learn collaboratively, they generally learn better when they complement one another in knowledge. Both cooperative and collaborative learning strategies involve group discussions. However, when group members meet face to face, they may be influenced by interpersonal relationships and peer pressure, which can cause group members to interact in less desirable ways. The purpose of this study is to investigate whether peers engaged in group discussions for the purpose of collaborative learning interact differently in face-to-face or anonymous conditions. The study examines how peers assess one another, to identify group interaction patterns. Different interaction patterns may result in different learning achievements, and this study shows that anonymous group discussions tend to generate better results.

Index Terms—Collaborative learning, computer-mediated communication, group learning, interactive learning environments, learning strategies, peer interaction.

I. INTRODUCTION

COLLABORATIVE learning emphasizes co-construction of knowledge with peers, and is a popular teaching strategy. Webb [1] studied how peer-directed group work helps improve learning achievement, claiming that students learn better when learning activities are organized in such a way that group members trust one another, rely on one another, and work together to achieve the goals set out by the teacher. Many teachers employing e-learning resources also consider group-based learning to be important in assuring learning achievement [2]. Through face-to-face interaction and mutual assistance, students engaged in collaborative learning have the opportunity to learn and understand more about one another. Compared to traditional classroom teaching, students may become more motivated, and thereby achieve more [3]–[6]. For the team to succeed as a whole, it is important that all team members, and not just a few individuals, achieve their learning goals. Since all team members must work together to achieve this, it is necessary for everyone to practice his/her social and communication skills, including trust, exchange of ideas, respect, accommodation, and mutual assistance.

Collaborative learning activities may be carried out face to face, and this peer interaction enables group members to exchange their knowledge and discuss their perspectives, helping to not only unite the team, but also enable group members to collaborate and learn more effectively [3], [5]. However, there are also some disadvantages to face-to-face interaction. When students know one another reasonably well and meet face to face, those with a lower learning achievement may tend to rely on those with a higher learning achievement. This can in turn greatly reduce the effects of collaborative learning, an effect that becomes even more significant when students with a lower learning achievement also have little motivation to learn [7], [8].

If the influence of interpersonal relationships is too strong, there may also be internal competition or comparison within the group, or a sense (an “affective pressure”) of fear, boredom, and worry, which could make it less likely for group members to exchange their ideas [9]. To enable students to say what they truly feel, Wen et al. [10] proposed an anonymous peer assessment scheme. Some instructors also allow students to answer questions anonymously, by using handheld devices [11]. This not only greatly increases answer rates, but also helps to improve instructor–student interaction. Also utilizing the idea of anonymity, this study employs an anonymous brainstorming system, applying techniques similar to those of the Delphi method. The Delphi method [12] was devised to obtain a reliable consensus across a group of experts. In essence, the participants respond to controlled questionnaires. Each expert first gives his/her own answer to a question, and then provides feedback on the answers of the others. Upon receiving feedback his or her own answer, each expert then modifies it, and the process is repeated. The information flow proceeds in anonymity to avoid direct confrontation between the experts. While the Delphi method is applied to a group of experts to obtain a reliable consensus, the brainstorming with anonymity system proposed here is to be used with ordinary students, to obtain consensus on answers to exam questions.

For Asian students, there may be additional peer pressure since Asian cultures in general, and Chinese culture in particular, discourage commenting about other people face to face, especially when there is an important relationship, such as a friendship or a classroom relationship, to be maintained. Asian students also tend to think that students with a higher learning achievement are more capable of giving the “right” answer to a question. As a result, there may be less room for discussion and peer assessment. One way of overcoming this “cultural constraint” is to conceal the identity of group members. Wen et al. [10], for example, devised a Web-based method for peer assessment, according to which group members are anonymous and can therefore assess each others’ contribution more freely. While this approach seems a feasible means for
enabling students to express a fuller and more frank assessment of others, it remains unclear how, or even whether, students assigned to the same group can work together without knowing each other’s identity. This study therefore investigates both the possibility, and the details, of such a peer review mechanism.

The two questions of this study can be articulated as follows.

• Question 1: Will students assigned to the same group really work together when they do not know each others’ identity?

• Question 2: How will anonymous group discussion affect peer interaction and learning achievement?

To carry out this investigation, a system was developed to enable students to brainstorm anonymously. Within this system, peer review proceeds in three phases: 1) question-answer; 2) group discussion; and 3) final assessment. By analyzing how peers assess one another, and how they interact differently in face-to-face and anonymous environments, it is possible to identify group interaction patterns [13]. The results can then be evaluated to determine how changes in peer interaction patterns affect overall learning achievement.

The remainder of this paper is organized as follows. Section II surveys related work. Section III describes the system used in the experiment. Section IV describes two experiments that were carried out in the Fall semester 2009 and the Spring semester 2010, respectively, and also presents both the online questionnaire used in the experiment and the results. Section V discusses related issues, and Section VI presents the conclusions and suggestions for future research.

II. RELEVANT RESEARCH

A. Collaborative Learning and Grouping

Collaborative learning can be considered to originate from social constructivism [14]. As Heylighen [15] explains, “[social constructivism] sees consensus between different subjects as the ultimate criterion to judge knowledge. ‘Truth’ or ‘reality’ will be accorded only to those constructions on which most people of a social group agree.” In other words, the way an individual constructs his/her own knowledge is by co-construction and consensus with society as a whole. For each learner participating in collaborative learning, this “society” is the group to which the learner belongs.

Collaborative learning requires group work. Researchers suggest various factors and strategies involved in setting a group assignment. For example, it is crucial to ensure an appropriate group size. If the group is too large, then it may be difficult for all members to participate fully in learning activities. Hwang and Lin [16] suggest that an appropriate group size is three or four students.

B. Model of Interaction

There has been a continuous trend in the development of online discussion platforms. From the early bulletin board system (BBS) to the currently popular online “social” systems, such as Windows Live Essentials [18], Facebook [19], and even Twitter [20], constant use of online discussion platforms has become part of everyday life for today’s college students. Consequently, educators nowadays use Web platforms to assist the teaching and learning of various subjects. By using Web platforms, students are able to engage in many learning activities such as self-reading, self-testing, and online/offline discussions.

Students’ online discussions are frequently unstructured, and participants may find it difficult to extract useful information. Kunz and Rittel [21] proposed using an issue-based information system (IBIS) for online discussions. By using IBIS, students are able to structure discussions, for example, by asking and answering questions, and suggesting arguments for or against the proposed answers. Subsequently, Conklins and Begeman [22] developed a graphical user interface for the IBIS model of interaction, and Eggersmann et al. [23] analyzed data from student activities conducted through an IBIS-based online discussion platform.

The IBIS model of interaction consists of three parts: issue, position, and argument. First, students raise issues or questions for discussion. Second, students can make position statements about each issue. Finally, they can make arguments for or against each position statement. An argument can either clarify or elaborate on a position statement, helping to make the position statement more complete. With the use of an IBIS-based platform, group discussions become more goal-oriented and focused, enabling participants to reach a consensus more quickly, if, indeed, such a consensus is to be found.

C. Peer Interaction

On the basis of the theory of social construction [24], [25], collaborative learning aims to help learners solve the problems they encounter in learning and to improve their own learning behaviors [26]. One of the long-standing goals of education has been to help learners learn better through appropriate patterns of peer interaction [27], [28]. Ideal peer interactions are those in which learners first present their own ideas (their answers to a given question) and then develop those ideas through discussion with their peers and exercising their own judgment [29], [30]. Liu and Tsai [13] used an IBIS-based platform for online discussions and identified the following five peer interaction patterns from the data they collected.

1) Centralized knowledge exchange: One student plays the role of knowledge provider, serving as the major source of answers to questions.

2) Distributive knowledge exchange: There is no single source of knowledge, and group members discuss what they know to reach a consensus.

3) Group development impediment: There are many discussions. However, the discussions tend to focus on group development, and there is often no consensus.

4) Ability impediment: The knowledge of all group members is limited, making it difficult for them to make meaningful progress in their discussions.

5) Partial knowledge exchange: Not all group members participate in the discussions. However, those who do participate in the discussions are not necessarily considered “sources of answers.”

D. Peer Assessment

Peer assessment means trying to assess, from the perspective of the instructor, the values or quality of what one’s peers (i.e., those of a similar background) have accomplished [31], [32]. This carries two key benefits for students: On the one hand, assessing the work of others helps students to evaluate their own
work; on the other, those being assessed may consider peer assessments to be more acceptable than assessments made by the instructor and may consequently be more willing to improve their work. Peer assessment not only helps students to think in a positive way about the evaluation of their work [33], but also helps them to achieve better outcomes [34], [35]. When peers assess each others’ work, they use their own language and communicate in their own way. Compared to the language and approach used by the instructor, peer assessment may help the student being assessed to understand the advantages and shortcomings of his/her work more effectively [36]. A widely used system for conducting peer assessments is the Comprehensive Assessment for Team-Member Effectiveness (CATME) [37].

Although peer assessment has the potential to help students learn better [38], [39], it can also cause anxiety [9], [40] because students may fear that judging one another could lead to hard feelings. Students may also avoid commenting on those with greater academic performance. To tackle this problem, Wen et al. [10] developed a Web-based method that allows peers to assess one another without revealing their own identities.

III. SYSTEM FOR ANONYMOUS BRAINSTORMING

For students to participate in group discussions without worrying about interpersonal relationships and peer pressure, a system has been developed for brainstorming on the Web while remaining anonymous (Fig. 1). Groups are assigned automatically and immediately by the system, and the students do not know the identities of their colleagues.

This system operates in three phases. The first phase is for self-testing, during which each group member gives his/her answers to all of the questions. The second phase is for group discussion and voting: Each question is reviewed simultaneously by all group members, by displaying all the answers given, and then allowing the members to discuss these answers in an online chat room. Each group member has the opportunity to modify his/her own answer, according to the suggestions and criticism of others, following which an online vote is held to determine the best answer. The third phase is the assessment, wherein each group member assesses the value and contribution of his/her colleagues. These assessments are then used to determine group interaction patterns.

IV. EXPERIMENTS

A. Two Experiments on Group Discussion

To determine how anonymity affects peer interaction and learning achievement, two experiments were carried out during the academic year of 2009–2010 (Fig. 2). Experiment 1 provided face-to-face conditions for group discussion, while experiment 2 ensured anonymity. Participants in both experiments were juniors within the Department of Information and Computer Engineering at Chung Yuan Christian University, Taiwan. In Experiment 1, the 111 subjects were enrolled in System Programming, a required course, in the Fall semester of 2009. In Experiment 2, the 117 subjects were enrolled in another required course, Operating Systems, in the Spring semester of 2010. Since these were both required courses, the participants in each experiment were essentially the same, except for some students retaking one of the courses from a previous year. There were three learning stages in Experiment 1, and two learning stages in Experiment 2 (Table I). During each learning stage, there were two or three checkpoints, and at the end of each checkpoint and learning stage, there was an associated review session. Each review session consisted of a group discussion and lasted about an hour.

In each review session, the subjects were divided into groups, with three members per group. The groupings were determined at the beginning of each learning stage and remained unchanged throughout the stage. At the beginning of Experiment 1, the subjects answered a questionnaire about their thinking styles [11], [41]. On this basis, the grouping strategy for review sessions associated with the first learning stage of Experiment 1 was to include complementary thinking styles, that is, attempts were made to include subjects of varying thinking styles (administrative, legislative, and judicial [11], [42]) in each group. For the subsequent two learning stages of Experiment 1, and both learning stages of Experiment 2, the possession of complementary knowledge was used as the grouping strategy [43]. First, the knowledge structures of the students were identified, and then a previously developed algorithm was used to assign group membership accordingly [42], [43]. The students’ knowledge acquisition was determined by requiring all students to complete a conceptual-graph-based certification test at the end of the first two learning stages of Experiment 1 and the first learning stage of Experiment 2. The results were used to form groups for the next learning stage with a complementary range of knowledge [17]. In addition, the results of the final exam for the System Programming course were used in determining group memberships for the first learning stage of Experiment 2. Before Experiment 1 began, the subjects were asked if there were students with whom they did or did not want to be grouped. This additional information was used as a secondary consideration for group member selections.

Fig. 2 presents the procedure used in both experiments. The instructor designed a concept map on the basis of the content of the course and the syllabus. To learn each concept, students attended lessons, read online course materials, viewed recorded course videos, etc. At each checkpoint, and at the end of each learning stage, students attended review sessions, which included a group discussion and peer review. A typical review session proceeded as follows: At the beginning of the session, all subjects received the same list of questions; after
each group member had submitted his/her answers, the group entered its group discussion phase, the purpose of which was to reexamine the answers and to develop the best answer for each question. In this process, everyone could modify his/her original answers in response to the suggestions or criticism of other group members.

In both experiments, all students attended the review sessions at the same time. In Experiment 1, group members sat together and discussed their written answers face to face. In Experiment 2, meanwhile, group members were scattered across computer rooms, were required to conduct discussions using the system described in Section III, and were prohibited from revealing their identities during the discussion.

At the end of each learning stage, all subjects were required to complete an online questionnaire outside of class. Since the participants in both experiments were basically the same students, there were no significant differences in their background knowledge. The post-tests of each experiment were the final exams.

B. Questionnaire and the Analysis Method

In previous research, Liu and Tsai [13] identified five peer interaction patterns. On the basis of their findings, a questionnaire was designed to help identify these patterns in the present study. Table II presents the list of 18 questions used in the questionnaire. Except for the last three questions, the subjects answered by selecting answers from a five-point Likert scale. Students used the questionnaire to express how they felt. They were not made aware of the interaction patterns being tested in the questionnaire, nor did they know which question was related to which interaction pattern.

To confirm the usability of this questionnaire, a factor analysis was performed, by means of the Statistical Package for Social Science (SPSS) package. A Kaiser–Meyer–Olkin (KMO) test and Bartlett’s test of sphericity were first performed to ensure sampling adequacy, a prerequisite for factor analysis. The KMO test measures sampling adequacy, providing an index to determine the appropriateness of factor analysis. A KMO value above 0.5 indicates that factor analysis is appropriate, while a KMO value below 0.5 implies that factor analysis may not be appropriate. Bartlett’s test of sphericity tests the null hypothesis that the variables in the population correlation matrix are uncorrelated (i.e., the population correlation matrix is an identity matrix). If the observed significance level is small enough to reject this hypothesis, it means that the strength of the relationship among variables is strong and that a factor analysis for the collected data is appropriate. The KMO value for the questionnaire results was found to be greater than 0.657, and Bartlett’s sphericity test values were found to be greater than 543.571, with the level of significance being 0.000. These results suggested that a factor analysis was appropriate. The interpretation of the cumulative total variance for the questionnaire, obtained through factor analysis, was greater than 74.869%, and the factor loading for each factor was greater than 0.612. This means that the questionnaire had good construct validity. The Cronbach’s $\alpha$ of each factor was greater than 0.759, meaning that the questionnaire was internally consistent and reliable [44].

For each group, the analysis of the possible peer interaction pattern proceeded as follows. First, the students’ answers to Questions 1–15 were analyzed. For each interaction pattern, there was a corresponding set of questions (a “question set”) in
TABLE II
ONLINE QUESTIONNAIRE

<table>
<thead>
<tr>
<th>Interaction Pattern</th>
<th>Number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial knowledge exchange</td>
<td>1</td>
<td>There were group members who did not participate in the discussion.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>There were group members who did not express any opinion during the discussion.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>I was somewhat displeased, because one or more group members not participate in the discussion.</td>
</tr>
<tr>
<td>Distributive knowledge exchange</td>
<td>4</td>
<td>Everyone expressed his/her opinions during the discussion. We all exchanged ideas.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>I was quite busy exchanging ideas with our group members.</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>All group members provided various ideas in the discussion.</td>
</tr>
<tr>
<td>Ability impediment</td>
<td>7</td>
<td>The knowledge of our group members was limited, making it difficult for us to have a meaningful discussion.</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Our discussion was not useful. I think it was because our group members did not have adequate knowledge in the first place.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>My knowledge is limited. Therefore, I could not give useful opinions during our discussion.</td>
</tr>
<tr>
<td>Group development impediment</td>
<td>10</td>
<td>Everybody thinks differently. It was quite hard for us to reach a consensus.</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Our discussion was quite diversified, making it difficult for us to arrive at any conclusion.</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>We did not have much discussion. Therefore, we did not arrive at any conclusion.</td>
</tr>
<tr>
<td>Centralized knowledge exchange</td>
<td>13</td>
<td>We basically just used a particular group member’s opinion in answering the questions.</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>We had someone knowledgeable in our group. That made it simple for us in discussing what the answers to the questions should be.</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>There were group members who led us in the discussion. Therefore, it was easy to arrive at a common conclusion.</td>
</tr>
</tbody>
</table>

the questionnaire. By adding up a student’s assessed scores for all questions in a question set, the student’s score for the corresponding interaction pattern was obtained. By comparing all of a student’s scores, the student could be said to have “picked” a peer interaction pattern for their group. If more than one member of a group picked the same peer interaction pattern, such as centralized knowledge exchange, then the peer interaction pattern of this group was considered to be centralized knowledge exchange. If every member of the group picked a different peer interaction pattern, then their answers to Questions 16–18 were used to determine the possible interaction pattern of this group. This latter analysis also included the comparison of all members’ original answers with their final “group answers.” If difficulty remained in determining the overall interaction pattern of the group, then lab observations (for Experiment 1) and online activity records (for Experiment 2) were examined. Online activity records included not only students’ participation in the Brainstorming Peer Review System, but also the content of their online discussions.

V. RESULTS AND DISCUSSION

Table III presents a summary of the peer interaction patterns exhibited in all learning stages. Figs. 3 and 4 illustrate the distribution of post-test (the final exam) scores in Experiments 1 and 2, respectively.

Two observations can be made on the basis of Table III. First, when the (main) grouping strategy was complementary knowledge, and group discussions were conducted face to face, the predominant peer interaction pattern was centralized knowledge exchange. (There was no predominant peer interaction in the very first stage of Experiment 1. This was probably because of the grouping strategy, which used complementary thinking styles.) Second, anonymous group discussions were associated primarily with the peer interaction pattern of distributive knowledge exchange, even though the (main) grouping strategy was again complementary knowledge.

Why was there such a striking difference in the predominant peer interaction pattern of groups assigned according to the same grouping strategy? The answer obviously lies in anonymity. When group members were familiar with one another and met face to face, it was only natural that those who were typically low achievers decided to let those who were typically high achievers give “the right answer.” However, when group members “met and discussed” anonymously, through a computer system, they had no choice but to seek “the right answer” through a discussion process, to which everyone contributed. This phenomenon was reflected in the answers
TABLE IV
RESPONSES FROM TWO GROUPS IN EXPERIMENT 2

<table>
<thead>
<tr>
<th>Question</th>
<th>ID</th>
<th>Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. Who, in your opinion, contributed most to the group discussion?</td>
<td>A1</td>
<td>A1</td>
</tr>
<tr>
<td>17. Do you think group discussion helped you improve in your learning?</td>
<td></td>
<td>17. Yes.</td>
</tr>
<tr>
<td>18. As far as the answering of exam questions is concerned, what do you</td>
<td></td>
<td>18. It was interesting.</td>
</tr>
<tr>
<td>think of cooperation with anonymity as compared to cooperation face to face?</td>
<td></td>
<td></td>
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A2
17. Some answered in detail. Some did not contribute. It was good to learn from this.
18. We could talk more freely without feeling embarrassed.

A3
17. Yes, sometimes the discussion reminded me of what I had forgotten.
18. I could say something I was not sure of and then talk about it. Very good.

B1
17. So-so.
18. Good. This way, everybody has to study, and we could not set up anything in advance.

B2
16. B3.
17. Yes.
18. Very good. Ideal arrangement. I like it very much.

B3
16. B3.
17. Yes. Once we had identified answers that were wrong, it left a deep impression in me.
18. It indeed forced us not to rely only on those equipped with the relevant knowledge.

TABLE V
RESPONSES FROM MEMBERS OF A PARTICULAR GROUP IN EXPERIMENT 1

<table>
<thead>
<tr>
<th>Model of Peer Interaction: Centralized knowledge exchange</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
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<tr>
<td>----</td>
</tr>
<tr>
<td>A</td>
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<tr>
<td></td>
</tr>
<tr>
<td>B</td>
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<tr>
<td></td>
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<tr>
<td>C</td>
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</table>

TABLE VI
RESPONSES FROM MEMBERS OF THE SAME GROUP IN EXPERIMENT 2

<table>
<thead>
<tr>
<th>Model of Peer Interaction: Distributive knowledge exchange</th>
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<tr>
<td>ID</td>
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<td>A</td>
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</tbody>
</table>

to the questionnaire. Table IV presents some of the answers for Questions 16–18 in Experiment 2. These answers were given by members of two groups, where “A1,” “A2,” “A3,” “B1,” “B2,” and “B3” represent three group members each of groups A and B.

In some cases, the peer interaction pattern of a group even switched from a centralized to a distributed knowledge exchange. Tables V and IV present such an example. Although they were unaware of this, three subjects happened to be assigned to the same group in both Experiment 1 and Experiment 2. Therefore, as Table VI shows, they altered their behavior to suit the conditions of anonymity, just as did many other subjects, and everybody contributed in the deliberation process. As a result, whereas the peer interaction pattern of this group had been a centralized knowledge exchange in Experiment 1, in Experiment 2 it became a distributive knowledge exchange.

Although it is difficult to accurately contrast the results of the final exam in the two different courses, it is nevertheless desirable to have a distribution of scores such as that shown in Fig. 4. In a sense, Figs. 3 and 4 reflect what was observed from the collaborative behaviors exhibited by the subjects in Experiment 1 (face to face) and Experiment 2 (online, with anonymity). In both experiments, each group discussion served as a review session for the approaching (midterm or final) exam or quiz. Therefore, it is quite clear why there was such a difference in class performance for each experiment. In Experiment 1, when group members relied on only one group member to come up with “the right answers” for the review questions, only the group member who served as the “knowledge center” benefited from the process. In Experiment 2, meanwhile, when all group members had to participate in the deliberation process, to try to identify “the right answers” to the review questions, it is only natural that they all clarified their thoughts in the process. Therefore, in Experiment 1, only those who served as “knowledge centers” got a higher score, whereas in Experiment 2, many more subjects exhibited a higher learning achievement.

Is it the case, therefore, that a complementarity of knowledge is not important? To answer this question, it is important to observe what happened in the review sessions of the very first learning stage (Experiment 1), as presented in Table III. While it is true that many peer interaction patterns in this stage were modeled on a distributed knowledge exchange, there were, nevertheless, also many peer interactions of the ability impediment pattern. In comparison, there were fewer peer interaction patterns with either ability impediment or group development impediment in Experiment 2. One explanation for this could be that in the very first learning stage of Experiment 1, the grouping strategy was the complementarity of thinking styles, whereas in all other learning stages, the grouping strategy used was complementary knowledge. In other words, the conclusion that anonymous group discussion may be better than group discussion face to face is based on the assumption of a complementary knowledge grouping strategy.

As Tables V and VI suggest, the same group of students may change their interaction pattern when the format of group discussion changes. More specifically, they may employ centralized knowledge exchange when the group structure is face to face, but distributive knowledge exchange when the group structure is anonymous. In face-to-face discussions, there is a tendency for academically weaker participants to rely on academically stronger colleagues, resulting in a centralized knowledge exchange pattern of interaction. Yet when the same group of students takes part anonymously in online discussions, they may all study harder to avoid being “dragged down” by members who are academically weaker. It is also more likely that each group member will express their opinions online in an anonymous setting, contributing to the establishment...
of a distributive knowledge exchange pattern of interaction. This pattern makes the group members feel a higher level of satisfaction overall, enhancing both their learning motivation and their learning achievement.

The two questions raised in Section I can now be answered. Both answers assume that the main grouping strategy applied is a complementarity of knowledge. The answer to Question 1 is positive: With the use of a system similar to that described in Section III, students can and will cooperate anonymously. The answer to Question 2 is twofold. First, when the students participate in an anonymous group discussion, distributive knowledge exchange becomes the predominant peer interaction pattern. Second, compared to face-to-face group discussion, anonymity can help students to improve their academic performance, as Figs. 3 and 4 illustrate.

VI. CONCLUSION AND SUGGESTIONS FOR FUTURE WORK

In this paper, it has been shown that when complementary knowledge is used as the main grouping strategy, group discussion with anonymity is more effective than group discussion face to face. When group members participate in an anonymous computerized review session, they have no choice but to go through a deliberation process to arrive at “good” answers to the review questions. Since no one knows who the best student is, everyone has to contribute to the deliberation process to develop acceptable answers. In so doing, everyone has the chance to clarify his/her own thoughts and concepts since there are often “good” alternatives, such as those proposed by the more knowledgeable students, with which to compare one’s own answer. In contrast to this, face-to-face group discussion may encourage students to rely on the more knowledgeable participants. Face-to-face group discussions that include more knowledgeable students may also provide less room for discussion, which could, in turn, result in less overall improvement for the class as a whole.

By using a system that helps group members conceal their identities, students are less affected by interpersonal relationships and peer pressure and are therefore more willing to participate fully in discussions, learning more from the process as a result. One of the goals of collaborative learning is to facilitate frank and productive group discussions. Anonymous group discussion may be closer to this ideal than group discussions conducted in face-to-face conditions.

For cooperative learning (another common teaching strategy), however, anonymous group discussion is not totally suitable because of the strong emphasis on teamwork and interpersonal skills in cooperative learning. Group discussion and teamwork are both important elements of cooperative learning. While this research demonstrates that anonymous conditions are better than face-to-face conditions for group discussion, this is only insofar as it encourages students to express their opinions more freely, without worrying about the presence of those that are known to be academically stronger. From the perspective of cooperative learning, a distributive knowledge exchange pattern of interaction in a face-to-face structure is much more desirable.

Nevertheless, when applying the strategy of cooperative or collaborative learning in teaching, it is advisable that the instructor takes note of the peer interaction pattern of each group. If the goal is to cultivate leadership, then a peer interaction pattern of centralized knowledge exchange is fine. Otherwise, the instructor should try to help the group to change its peer interaction pattern to distributive knowledge exchange. One of the future directions for research is to identify specific ways of changing the peer interaction pattern of groups in situations where face-to-face interaction is essential.

On the basis of the results of this experiment, it is clear that the same group of students may use different peer interaction patterns to suit the format of group discussion. To further explore the influence of different discussion formats, it would be desirable to perform further experiments in which the experimental group and the control group conduct group discussions at the same time, but under different conditions.

When students are allowed to express their opinions anonymously, they tend to speak out more freely, and sometimes in a more aggressive way. However, anonymity is not a panacea for learning. Freeman and Bamford [50], for example, suggest that anonymity may encourage students to make inappropriate comments, thereby causing a negative effect on the learning achievement of other students. Therefore, anonymous group discussion is only a starting point for this research. Having encouraged students to participate actively in anonymous group discussions, it is hoped that successive steps can be taken to further encourage these students to engage in group discussions face to face.

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REFERENCES


