TRANSFER OF EMERGENT LEADERSHIP FROM COLLABORATIVE DISCUSSIONS TO COLLABORATIVE PROBLEM SOLVING

BY

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THESIS

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Abstract

Transfer of learning has been an important goal of teaching. Most research studies have focused on the transfer of content knowledge; however, do children transfer the social skills they have learned from one group activity to another? By using the approach of Collaborative Reasoning (CR) discussion and Collaborative Problem Solving (CPS), this study examined the transfer of children's emergent leadership skills across these two different group activities. 252 students from 4 fifth grade classes in Mideast China took part in this study. Analysis of pre and post surveys, and videotapes of 8 groups' CPS revealed that, as compared to students who received no CR discussions, students who experienced CR discussions initiated more effective leadership moves in the CPS activity. Furthermore, CR students had much more positive feeling and higher evaluation of collaboration in their comments about the discussions than control students; they were also more confident in sharing their thoughts in the CPS activity.

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Chapter 1

Introduction

Although the potential benefits of collaborative learning has well been documented (Johnson & Johnson, 1990, 2003; Slavin, Madden, Dolan, & Wasik, 1995), group learning is often difficult to navigate socially. Ideally, educators have hoped and trusted that collaborative learning groups could operate effectively on their own. In reality, however, groups can have such problems as a dominating member (Yamaguchi, 2001), which can result in inequities in learning (Webb, Nemer, Chizhik, & Sugrue, 1998). Recently, some researchers (Li et al, 2007; McMahon & Goatley, 1995) have noticed an interesting phenomenon associated with collaborative learning that student leaders emerge during group meetings, and begin to take the teacher's role and facilitate the learning of the whole group.

The Concept of Children's Leadership

As with many popular constructs, leadership has a multitude of definitions. Leadership is also a word in common English usage, and so has many connotations outside of the research community. Owen (2007) found that many young children equate leadership with being "bossy" while older children thought that leaders should be confident, kind, clever and good listeners. Teachers looked for a student who is confident, expressive, independent, a good listener, and someone willing to help others. These findings suggest that both teachers and older students

identify leadership as a characteristic of individuals who are both extroverted and nice. The trait definition of leadership has also been used by researchers who conceptualize leadership as a set of characteristics that are possessed by individuals in positions of power (Morris, 1991).

Because a set of fixed personality traits can hardly predict leadership in diverse situations (Chemers, 2000), some researchers began to think of leadership as a cluster of leadership actions and child leaders emerge through actions that help groups achieve goals (French & Stright, 1991; Hartup, 1983; Sorrentino & Field, 1986). French and Stright examined emergent leadership behaviors among second, fourth, and sixth graders, and they found that task facilitation, solicitation of opinion, and record keeping were as rated by both group members and observers as the indicator of leadership status. Hartup (1983) concluded that children who were able to direct and organize group activities and promote the achievement of the group goals were highly likely to emerge as leaders during middle childhood.

In the context of collaborative learning where students need to collaborate with each other, I feel it's more interesting to look at the leadership as a reciprocal social process in which different individuals take on the leading roles guide, coordinate, or enhance the behavior of other individuals acting as followers. Besides, instead of focusing on the individual traits that are predetermined and will hardly change in a short time, I think it's more valuable to look for the possible transfer of emergent leadership by summarizing the leadership behaviors that help a

group achieve its goals. Therefore, the leadership I examined in this study has several features as below: First, it is a broad set of processes rather than a trait or skill. Second, as a process, the leadership role can be performed by a single person or multiple people, and the individuals performing the role of leader or follower can change over time. Third, the process must be reciprocal, because it requires the coordinated action of leaders and followers. As a result of these three features, leadership can be seen as an emergent property of the interaction of a group of leaders and followers rather than as merely the summative actions of individuals (Spillane et al., 2004).

One challenge for researchers to define leadership in children is the lack of accurate assessment technology to measure leadership adequately in children and youth (Oakland, Falkenberg, & Oakland, 1996). Previous investigations of children's leadership (Eby, Cader, & Noble, 2003) have relied almost exclusively on observer's perceptions of leadership, which is biased because adults' judgment standard of leadership can be completely different from children's perception. To solve this problem, I included children' self-report, peer nomination, and a moment by moment analysis of the leadership as it happened in children's actual collaborative group work.

Collaborative Reasoning

The current study examined children's transfer of leadership skills from Collaborative Reasoning (CR) to Collaborative Problem Solving (CPS) activities. CR is an approach to classroom discussion intended to stimulate critical reading and thinking and to be personally engaging (Anderson, Chinn, Waggoner, & Nguyen, 1998). In CR, children read a story and engage in interactive argumentation on a *Big Question* arising from the story. Typically, the Big Question presents a moral dilemma or policy controversy that does not have a single right answer. Children present their positions and reasons, use textual evidence to support their arguments, challenge each other, and respond to one another's challenges. Discussion becomes a process of working through complex issues, handling ambiguity and opposing viewpoints and holding one's own or letting go within a social context where children build their own web of argumentation. Students come to the discussion not just to present their arguments or challenge the positions of others, but in a cooperative effort, to explore alternative perspectives. Thus students are expected to listen carefully, respect each other's opinions, manage their own turn taking, and learn how to cooperate with peers.

Such an approach to discussion that features open participation and peer management contrasts with the teacher-dominant classroom discourse in China; however, previous research studies have found that Chinese elementary school children are able to quickly and smoothly adapt themselves to the free-flowing Collaborative Reasoning discussion format (Dong,

Anderson, Kim, & Li, 2008; Dong, Anderson, Wu, & Lin, 2010). Concurrent collaborative discussions are found to be feasible in a large classroom typical in China (Dong, Anderson, Wu, & Lin, 2010). Students are highly engaged in the discussions, and their reflective essays after several discussions show clearly the transfer of argumentation stratagems acquired from the oral discussions to independent writing. Students' responses to a survey showed that they held positive attitudes toward small-group discussions in the Collaborative Reasoning format because they liked the opportunity to reason together as a team.

Though Collaborative Reasoning discussions have the expectation for students to cooperate with each other, it's not certain, however, whether students will acquire the skills of cooperation spontaneously just from participating in discussions. Whether such skills as may be acquired would transfer to a different type of small group work has never been investigated.

Collaborative Problem Solving

Collaborative problem solving (CPS) is a subcategory of cooperative and collaborative learning in which students work together to find the answer to a specific problem. It is similar to CR discussions in the way that students take charge of the activity independently from the teachers, but different from CR discussions where there is no definite right or wrong answer; students need to reach a consensus understanding during CPS. CPS requires group members to support each other and collaborate efficiently so that the value of different knowledge and

perspectives can be maximized. By making use of the diverse knowledge sources, a group is enabled to create multiple solutions, combine the proposals together, and interpret them creatively either in a correct way or mistakenly (Chui, 1997). Individual comments, requests for clarifications, or questions may inspire other group members and move the group forward intellectually. Furthermore, group members can split the work into stages and put the partial solutions together for the final answer. They can also provide emotional support for each other to continue working even though the problems are apparently too hard to solve (Chiu, 2000).

Schema Theory of the Transfer of Social Skills

The theoretical rationales invoked to explain children's transfer of social skills across different domains derive largely from the schema theory (Anderson & Pichert, 1978; Gaines, 1987; Rumelhart, 1980; Schank & Abelson, 1977). A schema is an abstract knowledge structure that summarizes what is known about a variety of cases that differ in many particulars and represents the relationships among its component parts. Based on the schema-theoretic views of cognition (Anderson & Pearson, 1984; Rumelhart, 1980), Rezinitskaya and Anderson (2002) proposed an Argument Schema Theory (AST) to explaining findings about children's participation in CR discussions. AST assumes that the construction and comprehension of an argument, whether oral or written, depend upon an abstract knowledge structure, called an argument schema. Argument schemas are comprised of the structural and functional

commonalities students have acquired from their experience with argumentation. The richer and more stimulating the experience, the more refined and complete the argument schema are.

AST was proposed for achieving a unified understanding of learning in groups, and can be explained in terms of social learning ideas (Rogoff, 1990; Vygotsky, 1981). Vygotsky (1978, 1986) conceived of learning as a culturally embedded and socially mediated process in which discourse plays a primary role in the creation and acquisition of shared meaning making. Rogoff (1995) called one important type of social learning "participatory appropriation" (p. 156), which means ongoing development as people participate in events and thus manage subsequent events in ways modeled by their involvement in previous events.

With respect to social skills acquisition and transfer, Li et al. (2007) proposed a *leadership schema* theory which is composed of leadership moves as the "building blocks" (Anderson et al., 2001, p. 3) when analyzing students' leadership development in the CR discussions. The term of "leadership schema" incorporates knowledge about "the overall structure of group processes including the roles played by members, the functions served by leadership moves, the contingencies under which moves may be useful, the complementary relationships between leading and following, problems that may arise and possible remedies, and the temporal–causal flow of group activities" (Li et al., 2007, p. 79). Learning about leadership

through participation in group activities involves modification and further articulation of participants' leadership schemas.

Li et al. (2007) found that of the 12 discussion groups under study, half of them had a primary leader and one or more supporting leaders. Leadership was distributed among two or three leaders in all but one of the remaining groups. Frequency of leadership moves increased dramatically over the course of 10 discussions, indicating that children developed leadership skills as they became more familiar with their discussion group and this open-format discourse. Li et al. concluded that once children emerged as leaders, they were able to continue to lead discussions, despite variation of topics and other specific circumstances, as the children had abstracted effective leadership elements that were common across different situations.

By looking at another type of group work, CPS, the current study will first contribute to our understanding of whether the emergent leadership skills children demonstrated in CR discussions will transfer to another type of group activity. In addition, Li et al. (2007) and other researchers (e.g. Yamaguchi & Maehr, xxxx) have studied children's leadership as they worked within the same group of children, but no one has looked at how children behave when they work within a different group. Will a change in peer groups prevent children from using emergent leadership skills? The current study therefore has another purpose, that is, to test whether emergent child leaders can transfer leadership skills when they work with a different

group of children. In summary, the present study aimed to further the examination of children's emergent leadership skills in the context of collaborative group work, and find out if there are limits on the extent to which children are able to transfer these skills.

Chapter 2

Method

Participants

The study was conducted in the Yongqiao district of Suzhou City, Anhui Province, People's Republic of China. Two hundred and fifty three students (138 boys, 105 girls) from four fifth-grade classes in two elementary schools took part in this study. One school was in an urban neighborhood where most students were from families with the above average household income and their parents had a high school or higher education. The other school was in the suburban community where most students were from families with average or below average household income, and their parents in general had a middle school or high school education. The two schools used the standardized curriculum and final tests adopted by the whole district. The urban school had an extremely large student population, with 10 classes in each grade and an average class size of 80 students in each class; the suburban school was relatively small with only two classes at each grade level and an average size of 44 students. Within each school, the two participating classes were comparable in academic level and they were randomly assigned to either the control or treatment condition.

Procedure

Pre-survey. A sociometric survey measuring students' social relationship with classmates, usual classroom activities, and attitude toward small group work was given to every student at the beginning of the project (see Appendix B). The survey also asked students to nominate peers who usually are talkative, popular, have good ideas, and lead the class well.

CR lesson. After students finished the pre-survey, I gave the two treatment classes a 45-minute whole class CR discussion training session. As well documented in the paper describing the first CR study carried out in China (Dong, Anderson, Kim & Li, 2008), Chinese children are used to teacher-centered whole class instruction, and seldom have the chance to present extended ideas to the teacher or their peers. Therefore, CR discussions are very different from what Chinese students experience every day and, for them to succeed in CR, a lesson introducing the CR approach to discussion seemed necessary. The CR lesson was modeled after the one successfully used by Dong, Anderson, Lin, and Wu (2009) in their recent study carried out in Hefei, the capital city of Anhui Province. Dong (2009) found that a 45-minute CR lesson enabled Chinese students to understand the new discussion format well enough to initiate the first CR discussion entirely on their own.

Six CR discussion guidelines were introduced in the lesson, which I encouraged students to follow during their own CR discussions: (a) talking freely without raising their hands, (b) not interrupting others when they are talking, (c) inviting everyone to join the discussion, (d)

listening to other opinions with respect, (e) considering the issue from all aspects, and (f) thinking critically about the ideas instead of people.

I gave the two control classes a 45-minute whole class talk about my life in America as a first-year Ph.D. student, describing the culture differences I experienced, and encouraging students to ask me questions. The purpose of this control lesson was to minimize any difference between treatment and control conditions in students' motivation for participating in the research project.

After the lesson, teachers of the two treatment classes helped me divide the whole class into CR discussion groups (with 6-8 students per group) that were a balanced cross-section of the class in gender, talkativeness, and reading ability. Such balanced and heterogeneous group composition is considered to promote the emergence of multiple perspectives and intellectual and social leaders (Li et al., 2007). Because of the different class sizes, there were 11 CR groups in the urban classroom, 3 of which were randomly selected to be videotaped throughout the following 5 CR discussions. There were 6 CR groups in the suburban class, and two groups were selected for videotaping. I targeted selected discussion groups instead of the whole classroom because I wanted to capture accurately the details of students' discussions, including clearly-audible speech, facial expressions, body language and other social cues for later transcription and analysis.

CR discussions. In the following two weeks after the introductory lesson, the treatment classes had five concurrent CR discussions while the control classes continued their normal school lessons. The CR discussions were carried out during the time for Chinese reading and language arts. Copies of the story to be discussed were given to the students to read one day prior to the discussion. To make sure their conversation during the CR discussion were fresh and spontaneous, students were encouraged to read the story carefully but not to discuss it with other people before the discussion. Before students had the CR discussions, the desks and chairs were rearranged in the way that they could face each other while taking.

Students started the very first concurrent discussions on their own after I announced the big question. During the discussions, I walked around, stood next to a group listening for a while but never sat with a specific group. After 20 minutes, I asked the students to have a small group debriefing on their own, and then I led a whole class debriefing session. The purpose of the debriefing was to help students reflect on their performance during the discussion, share with each other aspects that need to be improved, and set goals for the next discussion. The debriefing could be about the social dynamics of the discussion or the quality of their ideas about the discussion topic.

CPS activity. After the 5 CR discussions were finished, I shuffled the treatment classes into new groups based on their math ability, talkativeness, and gender. There were still 11 groups

in the urban class and 6 groups in the suburban class. I had two purposes for regrouping the treatment students. The first was to eliminate the effects of learning to work with a particular set of children when comparing the group dynamics with the control class. The second was to make sure the CPS groups had the same average math competence. While for the CR discussions, children were grouped together based on their Chinese performance, such group might not be balanced in math ability; therefore regrouping procedure was necessary to balance the groups. At the same time, I divided the control classes into balanced, heterogeneous CPS groups according to the same criteria. There were 11 groups in the urban class and 6 groups in the suburban class.

Each group was then given about 15 minutes to solve three problems together (see Appendix C). Every student was provided with a piece of scratch paper but the whole group had only one question and answer sheet to share. The activity was set up to encourage a cooperative social process. Students were asked to achieve two major goals: making sure everyone in the group understands the solution before moving on to the next problem; and generating as many different solutions as possible. To decrease time pressure, I emphasized that it was fine if the students did not finish all the problems during the time allowed.

Instead of asking all the groups to work concurrently on the problem solving activities, two groups met at one time so that I could videotape each group while they were solving the

problems together. By videotaping every group, I planned to make a detailed comparison of the group dynamics of treatment and control groups during the CPS activity.

On the day following the group problem solving activity, all the students were given a final survey to fill out. For the treatment classes, the survey asked for their reflections about the CR discussions, the CPS activity, and their evaluations of the group members in both the CR discussion group and the CPS group (see Appendix D). For the control classes, the surveys asking about their reflections of their regular classroom discussions during the period of the study, the CPS activity, and their evaluations of the CPS group members (see Appendix E). The questions on the treatment and control surveys are parallel to each other. No additional tests were administered, but students' Chinese and math final grades for the spring semester were obtained from the school office as a measurement of their academic performance.

Stories for CR discussions

Five discussion stories with various themes were selected from the Collaborative Reasoning project at the Center for the Study of Reading at University of Illinois at Urbana-Champaign. All the stories had been used many times before and proved to lead to good CR discussion. I translated the stories from English into Chinese for this project. In the order in which they were used, the stories that served as the basis for the discussions were *Dr. DeSoto*

(Steig, 1982), *What Should Kelly Do* (Weiner, 1980), *A Trip to the Zoo* (Reznitskaya & Clark, 2001), *Marco's Vote* (Nguyen-Jahiel, 1996), and *Amy's Goose* (Holmes, 1992).

Dr. Desoto (Steig, 1982) tells a story about a mouse dentist, Dr. Desoto and a fox with a bad toothache. Dr. Desoto had a rule that he would never treat dangerous animals, but seeing the fox suffering from such pain, he was too kindhearted to turn him down. He found that the fox needed to have one of his teeth replaced, and the replacement could not be ready until the next day. He was concerned that if he let the fox return the next day, the fox would eat him after his toothache was cured. The question is: Should Dr. Desoto let the fox in for tooth replacement the next day?

What Should Kelly Do (Weiner, 1980) tells the story of a girl named Kelly who wants to win a painting contest. She is one of the best artists in the school; however, her friend Evelyn is even more talented in painting. On the due date, Kelly happens to see that Evelyn forgot to bring her piece of art from the outside and it is going to rain. The picture is so beautiful that Kelly knows she will not be able to win the first prize if Evelyn turned it in. The question is: Should Kelly tell Evelyn about her painting?

A Trip to the Zoo (Reznitskaya & Clark, 2001) describes two girls discussing an upcoming fieldtrip to the zoo. Lily is very excited about seeing animals while Amber shows her

hatred for the idea taking animals out of the nature and placing them in a zoo. The question is: Are zoos good places for animals?

Marco's Vote (Nguyen-Jahiel, 1996) talks about a meeting where student representatives, parents and teachers are trying to decide whether the school should buy new textbooks or computer software for the fifth grade. The question is: Which plan should Marco vote, the computers or the textbooks?

Amy's Goose (Holmes, 1992) is a lonely girl named Amy who finds an injured goose and nurses it back to health. She is a single child in the family and they live on an isolated farm where she doesn't have friends nearby. Amy is struggling to decide whether to keep the goose as a pet or to let it go free with the other wild geese. The question is: Should Amy let the goose go?

Problems for CPS activity

There were three problems in the CPS activity (see Appendix C): The first problem showed students an image of a four-digit number 2809 composed of 24 match sticks. Students were asked to make the biggest or smallest number by moving only two match sticks at one time. The second problem asked students to solve an equation $(1-\frac{1}{5})\ x = 18$, make a word problem based on this equation, and compare the answer with the one of $18 \div (1-\frac{1}{5})$. The third problem is a word problem where students needed to divide 19 buns into three piles, 1/2, 1/4, 1/5 without dividing a single bun into halves.

Chapter 3

Data Analyses

Two sets of analyses were performed: [1] macro-level statistical analysis of the pre and post surveys, and [2] micro-level discourse analysis of the CPS videos.

Survey analysis. The first step was to determine the major dimensions of students' school engagement *before* their participation in this project. A principal factor analysis was conducted on the 22 Likert scale questions in part B and C of the pre-survey (See Table A1). Two statistical criteria were employed to determine the number of factors to be extracted: the eigenvalue of the factor should be bigger than 1 and each factor should include at least 2 questions with loadings greater than .30. Besides the statistical criteria, I also looked at whether the factors permitted a coherent interpretation of the questions I asked. Applying these criteria, three factors were extracted, rotated, and named as follows: *active engagement in lessons, favorable attitude toward group activity,* and *extroversion*, which explained 41.34% of the variance of the scores. Factor scores were used as covariates for the analysis of the post surveys.

To determine the dimensions of students' engagement *after* participation in this project, principal factor analyses were then carried out separately on part A and C of the post survey. The first 12 questions in part A asked treatment students to rate their overall feeling towards the CR discussions and asked control students to rate the discussions in their Chinese lessons over the

previous two weeks. Three factors were extracted from these 12 questions, rotated, and named: *positive feeling towards discussion*, *comfortable group dynamics in discussions*, and *productive collaboration*. 48% variance was explained by the three factors (See Table A2). The 12 questions in part C asked students from both CR and control conditions to rate their overall feelings towards the CPS activity. Three factors were extracted, *comfortable group dynamics in CPS*, *positive feeling towards CPS*, and *confidence in sharing*. 52% of variance was explained by these three factors (See Table A3).

The six factor scores calculated from part A and C in the post surveys were used as dependent variables in six multiple regression analyses. Students' gender, Chinese and math grades, the pre-experimental traits of active engagement in lessons, favorable attitude toward group activity and extroverted personality were entered as first level predictors, condition as the second level predictor, and the interaction between condition and the other variables as the third level independent variables.

In the first regression model, *positive feeling towards discussion* was the dependent variable. Predictors that were not statistically significant were removed and the model was run again with only the three significant predictors: condition, students' previous engagement in lessons ($\beta_{engagement}$=. 21, t=3.45, p=.001) and favorable attitude toward group work (β_{favor}=.15, t=2.55, p=.01). Results showed that condition was a significant predictor (β

$_{condition}$=.37, t=6.21, p <.0001). CR students had much more positive feeling towards discussions than control students no matter whether they had high previous engagement in school lessons or not. There was an interaction between the control condition and students' previous engagement in school lessons ($\beta_{control*engagement}$= -.17, t=-2.96, p=.003), indicating that for the control students, the more engaged they were with school lessons, the more positive attitude they had towards the discussions in the regular Chinese lessons (Figure A1).

Comfortable group dynamics during discussions was the dependent variable in the second regression model. The predictor variables that were statistically significant were students' Chinese grade ($\beta_{Chinese}$ = .23, t=3.47, p=.001). The higher a student's Chinese grade, the more positive and comfortable he or she was about group dynamics. No difference was found between the control and CR conditions.

In the third regression model, *productive collaboration* was the dependent variable. Condition ($\beta_{condition}$=1.21, t=3.53, p=.001), favorable attitude toward group work (β_{favor}=.22, t=3.179, p=.002) and extroversion ($\beta_{extraversion}$ =.18, t=2.75, p=.006) were statistically significant predictors. Students who were in the CR condition, who liked group work and who were extroverts believed that they had more productive collaboration than students who were not. An interaction was found between condition and math ($\beta_{condition*math}$= -1.07, t=-3.09, p=.002). As shown in Figure A2, the higher a control student's math grade was, the higher their rating of

productive collaboration in discussions; however, among the students who experienced CR discussions, those with the lowest math grades actually thought most highly of the collaboration they experienced. The difference in students' rating for productive collaboration between the two conditions was largest among students with the lowest math grades, and decreased to almost zero among students with the highest math grades.

The fourth regression model used *comfortable group dynamics of CPS* as the dependent variable. No difference was found between the two conditions, but students' favorable attitude toward group work (β_{favor}=.14, t=2.16, p=.03) and extroverted personality ($\beta_{extraversion}$ =.27, t=4.27, p=.00) were significant predictors. Students who liked group work and who were extroverted rated their group dynamics higher in the CPS activity.

Positive feeling towards CPS was the dependent variable in the fifth regression model. No difference was found between the two conditions ($\beta_{condition}$=.10, t=1.5, p=.14), but students' favorable attitude toward group work was a significant predictor (β_{favor}=.20, t=3.11, p=.002), and there was interaction between a students' previous active engagement in school lessons and students' treatment condition ($\beta_{condition*engagement}$=-.18, t=-2.7, p=.007). Among the control students, the more engaged they previously were in school lessons, the more positive feelings they had towards CPS; which was the opposite of students who experienced CR discussions. Students who were least engaged in school before CR discussions changed to those who favored

the CPS most. As shown in Figure A3, among the students who were not engaged in school, those who experienced CR discussions had more positive feelings towards CPS than those who didn't participate in CR discussions.

The last regression model included *confidence in sharing* as the dependent variable. Students who had experienced CR discussions were more confident in sharing their thoughts in CPS than students who had not ($\beta_{condition}$=-4.82, t=-4.456, p=.000). Students who were previously more engaged in school ($\beta_{engagement}$=.16, t=2.5, p=.013), who were boys (β_{gender}=.14, t=2.2, p=.03), and who achieved high Chinese grades ($\beta_{Chinese}$=.42, t=5.7, p=.000) were more confident. There was an interesting interaction between the language ability and condition ($\beta_{Chinese*condition}$=4.8, t=4.5, p=.000); among students with low language ability as indicated by their final Chinese grades, those who had CR discussion experience were more confident in sharing their thoughts than those who had not; among students with high language ability, the opposite held true (Figure A4).

The coefficients of the six regression models are displayed in Table A4. Similar results were obtained in a multivariate analysis of covariance on the items in part A and C part of the post survey; students who experienced CR discussions had more positive feelings about both the discussions (Wilk's lamda= .72, F[12, 211]=6.716, p=.00), and the later CPS activity (Wilk's lamda= .907, F[12, 212]=1.801, p=.049).

Transcription of videos. Because of the large amount of labor involved in the transcription of video, I chose to examine a subset of the data for this report. I selected 8 out of the 34 groups' collaborative problem solving videos and transcribed these for the preliminary analysis reported in this thesis. I picked two groups from each of the 4 participant classes after viewing all 34 videos to make sure that the groups selected were representative of the overall discussion quality and group dynamic. To facilitate communication with my English speaking colleagues, I directly transcribed the Chinese conversations in English. The transcription was done with the goal of a complete faithful record of the talk and accurate identification of each speaker.

Coding leadership moves. The corpus of 8 selected discussion transcripts was organized, searched, and coded using QSR NVivo8 for qualitative research (Richards, 1999). It is important to note that although I considered some body language , the coding was based on the students' verbal utterances. A complete utterance, or 'full speaking turn,' was the unit of analysis (see Chinn, Anderson, Waggoner, 2001, for the definition of a 'full turn'). A total of 1,046 full turns for speaking were identified in the corpus and coded for leadership moves.

The coding process involved two phases: identifying the leadership moves and evaluating their effectiveness. In the first phrase, I randomly picked two videos and the corresponding transcripts to explore students' moves that were indicative of leadership based on the coding

system created by Li et al. (2007). Then after multiple discussions with another researcher after watching the videos and reading through the transcripts, I found it was desirable to modify the categories in order to capture most of the leadership moves actually occurring in the children's problem solving activities. The final four categories are *allocating tasks, proposing and justifying solutions, planning and organizing*, and *seeking consensus.*

Allocating tasks refers to giving directions for what should be done by whom, including the assignment of speaking and behavior turns. In the problem solving activity, students not only needed to brainstorm and discuss alternative ways to solve the problem, they also needed to do calculations and write down the answers, therefore directing the turns to those who had not spoken, or stopping those who interrupted others', or assigning the tasks to group members, all of which contribute to the problem solving process. The following examples illustrate typical utterances in this category with the bolded sentences coded as leadership moves:

Example 1:

Baiyu: Who is going to write?

Cailin: Me, me! (Take the sheet)

Baiyu: We should let the one whose handwriting is best to write.

(Cailin smiled and started to write on the sheet.)

Example 2:

Anni (use his pen to point to the graph): See, you move this match here, and another match here.

Gao: Wait, let him finish writing first.

(Silence, students were waiting for Chen to finish)

Baiyu: 9009.

Anni: The smallest number is 0009, you see, we move this match here,

Baiyu: yes, move the middle match here, 0009

The first example shows a student named Baiyu trying to assign the writing task to the group after they obtained the answer and needed to write it on the Q & A sheet. He also gave his suggestions about who should do this task. Student Cailin volunteered after Baiyu's request and no one was objected so the task was finished quickly. The second example is an illustration of the management of speaking turns. Anni wanted to provide his solution for making the biggest number with the match sticks; however, Cailin was still writing and would not be able to listen to his idea at the same time. Therefore Gao asked Anni to wait for a moment to make sure Cailin could concentrate and to make sure Anni's idea would be heard by everyone.

Proposing and justifying solutions referred to bringing up new ideas, soliciting reasons and clarification from others and ratifying other's arguments through paraphrasing or making comments on them. These moves not only helped the group to explore alternative solutions but

also insured that the proposed ideas were understood and accepted. An example at hand is when a student stated the biggest number he could get for the match stick problem, another student prompted him for further explanation of how he got the answer. These two moves helped the whole group move forward by introducing of a new idea and elaborating the way to work it out. Let's look at this example:

Jia: 9009!!

Gugu (raised her head, and talked to Jia impatiently): Don't tell me your answer!!!

Chao: Oh, I know (Put her finger on the graph of the 2809) Move the match here, so we get 9.

Ying also pointed her fingers on the graph.

Jia (described with his fingers): We should move the middle match of 8 to the front…

(Gugu moved Jia's hand away and stopped Jia from speaking)

Dong: Move to where? Show me again.

Bobo, Ying: Move this match here, and this match here, see, 9009

Dong: Oh, I see, yes.

In this episode, Jia initiated two leadership moves: the first one was when he gave his answer on what the largest number was; though Gugu tried to shut up Jie, Chao picked up Jia's idea and demonstrated it. Then Jia continued with elaboration on how to move the match sticks

to get 9009. Gugu was interrupting Jia's speech again, but from the later utterance of Bobo and Ying, we can assume that Jia's idea was accepted by the group. Bobo and Ying were not credited for extra explanation because they seemed to be just repeating Jia's idea. Dong was credited with one leadership move because she was asking for clarification from Jia, which had potential benefit for the rest group to rethink and consider the approach that Jia used to get the number. Proposing and justifying solutions can be viewed as intellectual leadership moves.

Planning and organizing means taking charge of the procedures and making good use of the time and resources. Though I emphasized the goal of the activity was to explore multiple solutions instead of rushing through the problems, students were still under the 15 minute deadline. Therefore it is important that some students took up the responsibility to remind the group of the problem constraints, save the team from arguing over nuisance issues and directing the group to make productive progress. Here are some examples:

Example 1:

Chenxi: We, our group has seven people, since they (the two boys) are making the word problem, we can have three people to think about the last question.

Li (say aloud his word problem while C is talking) A rope, cut down its 1/5, the rest is 18.

Tian (unsatisfied): What? No, no, let's just finish the second question together.

Ding, Li (annoyed): Let's do the question together,

Chenxi: But that way is more efficient.

Other students didn't listen to Chenxi, so they still worked on the question 2 together.

Example 2:

Yangyang: Look, see how I moved the matches.

Chenxi: What's the time right now? What's the time?

Yangyang: Let me see, move this match away, we got an 8, emm, no.

Chenxi: All right, stop arguing; let's just take 2008 as our answer.

Xu: (pat the table) next question, next question.

Chenxi started reading the question loud.

In the first episode, Chenxi found it unnecessary to have all seven students make up the word problem so she proposed to split the group for greater efficiency. It happened at the beginning of the CPS activity, about three minutes after they started, so most students were not under time pressure. Though the proposal was not accepted by her group members, Chenxi made an attempt to make good use of human resources. In the second episode, which happened around the 13^{th} minute when there was little time left and the group was still discussing the first problem, Chenxi decided to call for her group members to move on. This time she got support from Xu and was able to direct the group to the next question by reading it aloud.

Seeking consensus is about making sure that everyone understands the problem and get the same answer. For example, a boy who asked *"22.5, right? Did you guys also get 22.5?"* was trying to make sure that everyone was on the same page before they wrote the answer on the Question and Answer sheet and moved to the next question. This leadership move helped the group to work as a whole.

In the second coding phase, I evaluated all the leadership moves for effectiveness. By looking at the speaking turns after the leadership move, I checked whether the proposed action was carried out by the group member. The leadership moves were credited as effective only if they achieved the expected effect. For example, a child proposed a new idea, but the other group members didn't consider the idea. In that case, though the child was credited for initiating a leadership move, the move was ineffective. It should be noted that if a child used the same move twice during a single turn, only one was counted. Also if a certain leadership move by one child was followed immediately by the same or a similar move by other children, the first child would be given full credit for using the leadership move, while the second child would not get credit. A second rater re-coded a random 20% of the transcripts, and the reliability of the coding for this subset of the transcripts was acceptable, k=.77.

Three hundred fifty-one leadership moves were identified from the corpus of the 8 problem solving discussion transcripts, among which 301 moves were effective. The descriptive

statistics of the leadership moves of each group are shown in Table A5. Though some control groups have a similar total number of leadership moves as CR groups, the CR groups in general had a higher number of effective leadership moves than the control groups. Planning and organizing, and proposing and justifying solutions were the two major categories where almost each CR group had generated more leadership moves than the control groups. To have a better understanding of whether the leadership moves differed across the CR and control conditions, I further identified the individual total leadership moves and effective leadership moves of the 57 students in the 8 groups. Considering that the length of the CPS activity was not exactly the same among the 8 groups, the rate of generating total leadership moves and effective leadership moves per minute was calculated for each student. The rate data had a Poisson distribution and was transformed to a normal distribution using a log transformation.

The transformed leadership rate measures were entered as dependent variables in the following regression analysis. Students' math and Chinese scores, gender, condition, and the five traits obtained from the pre-survey nomination questions were used as predictors. In the pre-survey, students were asked to nominate the classmates who they thought were their best friends, smart, talkative, very quiet, and leaders in the classroom. Because of the different class sizes, I asked students from the large urban school to nominate no more than 8 classmates in each of the five questions, and students from the suburban school to nominate no more than 5 classmates per

item. I sorted the data, and calculated the total number of nominations for each student. These scores were then standardized within each class and used as an indicator of students' popularity, intellectual competence, talkativeness, shyness, and leadership potential.

Two regression analyses were carried out with the rates of individual total leadership moves and individual effective leadership moves as the dependent variables separately. There was no significant statistical difference between the two conditions in the total leadership moves ($\beta_{condition}$=0.23, t=1.60, p=.116); however, the difference between the two conditions in rate of effective leadership moves was significant ($\beta_{condition}$ =0.33, t=2.38, p=.02). Thus, the results supported the hypothesis that children would successfully transfer emergent leadership moves they learned from CR discussions to the CPS activity.

None of the social or attitude factors made a significant difference in students' generation of leadership moves during the CPS activity, but math achievement level was a strong predictor of leadership moves. The higher a student's math score, the greater the rate of total leadership moves (β_{math}=0.36, t=2.51, p=.015) and effective leadership moves (β_{math}=0.36, t=2.59, p=.013) that he or she initiated. This result was convergent with what Chui (2000) found in his study of middle school students' group problem-solving. He found that a student's mathematic grade, measured in terms of the midyear algebra grade, was a significant predictor of whether he or she would be perceived by the peers as the group leader in the CPS activity. Chiu used a

difficult algebra problem, which is different from the match stick problem that most groups in the current study were able to finish. However, to find the biggest or smallest number by moving only two match sticks required facility with numerals and spatial reasoning skills relevant to the math curriculum. Under speed accuracy pressure, following peers who were good at math was evidently perceived as a pragmatic group strategy. It seems that the children with high math competence were more confident to initiate leadership moves and likely to be followed by the other children.

Chapter 4

General Discussion

A major finding of this study is that children who experienced CR discussions were able to generate more effective leadership moves in the following CPS activity. Given the fact that there was no significant difference in the total leadership moves students attempted between the two conditions, I assume that students who participated in CR discussions were more likely to understand what types of leadership moves were helpful and acceptable to the group, and they were also more aware of the appropriate way to play the leading role in a group activity. Furthermore, a student's previous social status and personality traits were not significant predictors of the likelihood that he or she would attempt a leadership move. Nor did they predict the effectiveness of the leadership moves the student launched.

Vygotsky (1978) stated that, "The zone of proximal development defines those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state. These functions could be termed the 'buds' or 'flowers' of development rather than the 'fruits' of development" (p.86). In this study, I believe that every child has the potential leadership skills, but needs the guidance or appropriate environment for them to practice, and afterwards they can improve and master the skills. The five CR discussions provided students multiple chances to collaborate in a group, express their

own opinions, listen to others students and observe the group's endeavor in maintaining the discussion entirely on their own. For these Chinese children who were used to receive direct instruction from teachers and rarely had independent group work experience, these five CR discussions helped them to improve their social skills for collaboration.

Moreover, the post surveys showed that students believed that they had more positive feelings and more productive collaboration in the CR discussions than the discussions they had in their Chinese lessons, and motivation has been shown to be a key contributor to student learning (e.g., Guthrie et al., 2004; Pintrich, & DeGroot, 1990). Hidi (1990) concluded that interest influences students' attentional and retrieval processes, their expenditure of effort, and consequently their acquisition of knowledge. Students' high motivation in CR discussions not only helped them read and discussed the story in depth, but also motivated them to learn how to use the social skills for a productive CR discussion, and hence they practiced the leadership skills and learned how to effectively use them, therefore when they went to another group activity, they were able to apply the knowledge of leadership under new situation.

One unexpected result is that there was not much difference in students' reported feelings and evaluations of group dynamics during the CPS activity. I had anticipated that students who experienced CR discussions would have a more cohesive group dynamic, while students from the control classes might have problems cooperating with peers in a small group and finishing

work independently without teachers' instruction. One possible explanation for this unexpected result is that CPS was more of a fresh new discourse format for the control students than the CR students, and the excitement over the first-time experience lead to control students' positive self-report of this experience. One difference that did appear is that CR students reported being more confident in sharing ideas for solving problems as compared to students who only received regular classroom instruction; this held especially for students with low Chinese scores.

By replicating previous findings of children's emergent leadership with a group of Chinese fifth grade students, this study further supported the phenomenon of emergent leadership in children's collaborative groups. More importantly, this is the first study showing children's spontaneous transfer of the emergent leadership they acquired from collaborative reasoning discussions to collaborative problem solving activity. Without explicit teacher instruction, children were able to internalize the interpersonal and small-group skills through participation in CR discussions. Such interesting findings offer an innovative answer to the question of how to cultivate leadership skills from the elementary level while also provide a possible solution to teachers' concern about the behavior issues in the implementation of small group work.

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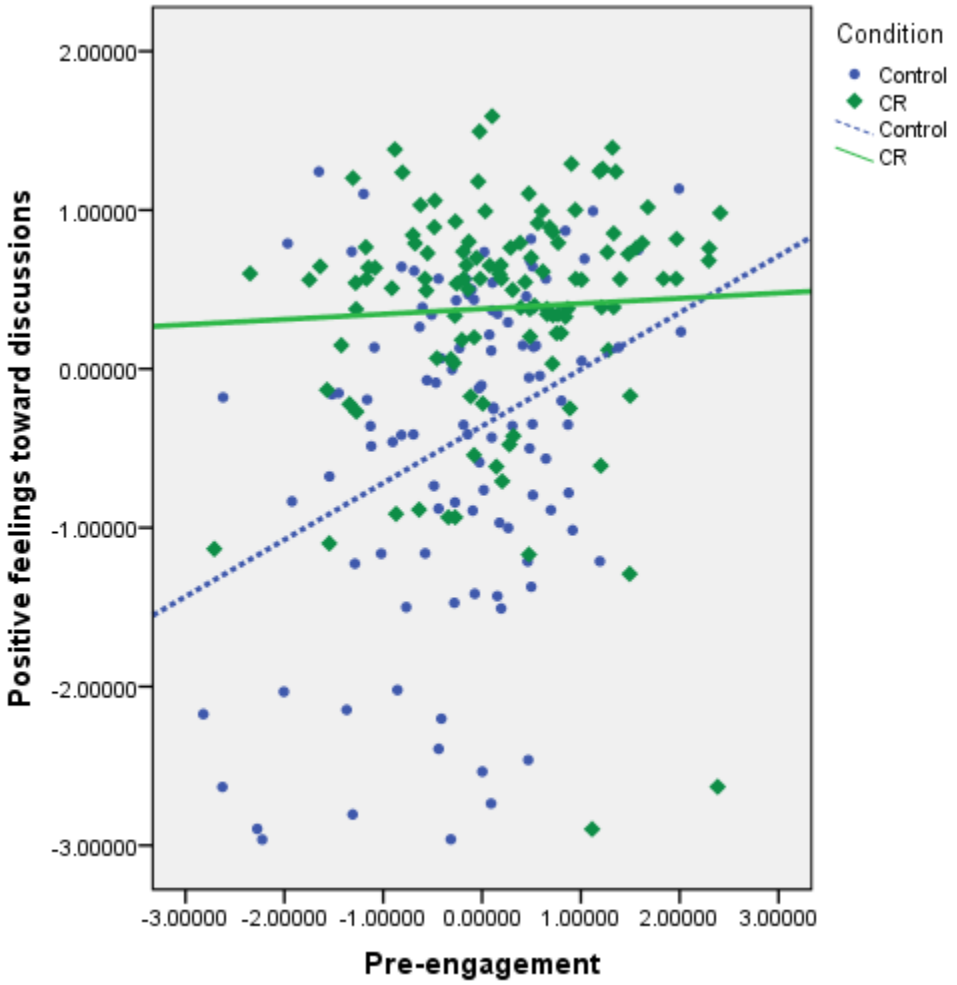
Appendix A

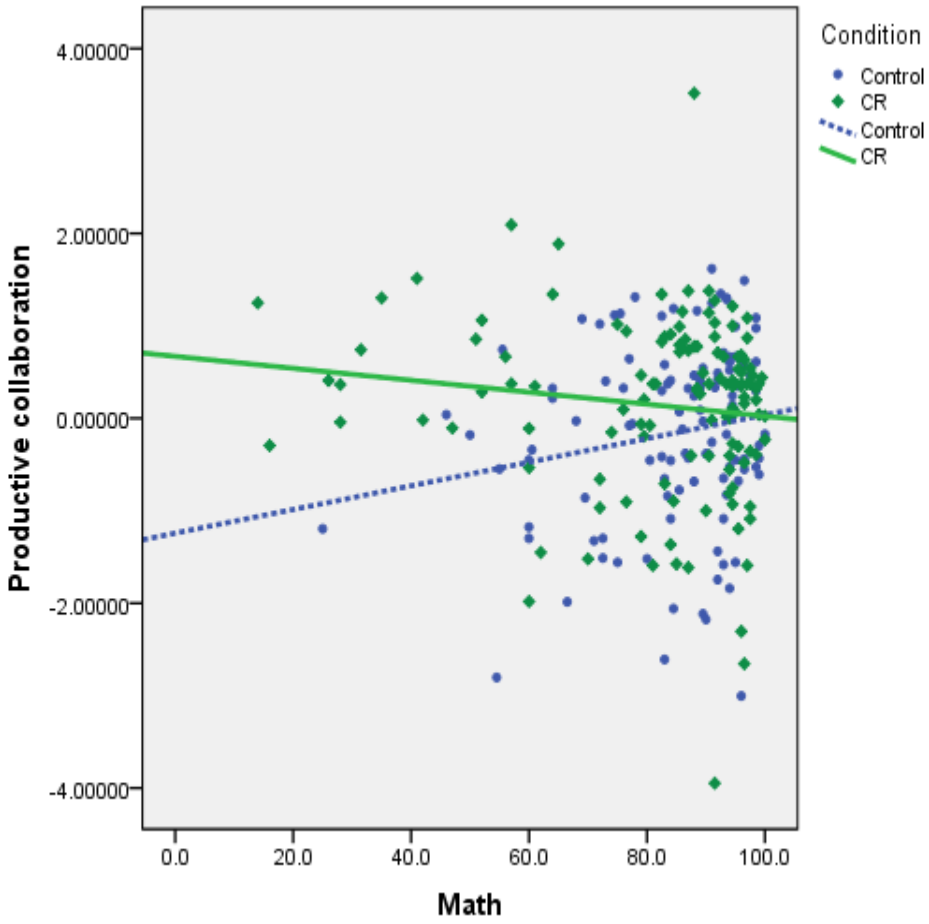
Figures and Tables

Figure A1. Students' pre-engagement in lessons and their positive feelings towards discussions.



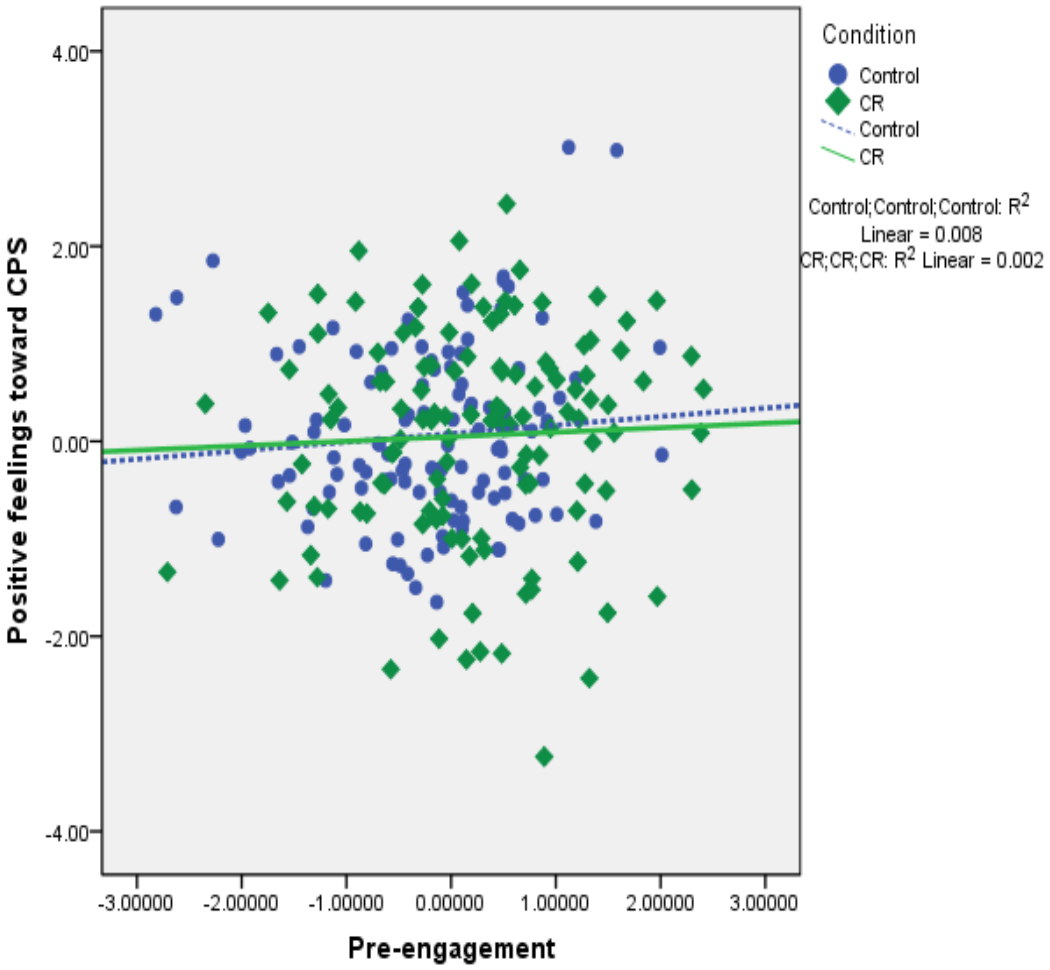
Note: All students' data are included and represented by the dots and diamonds in the figure. The slope of the fitting line is the regression coefficient of the linear relationship between students' pre-engagement in lessons and their positive feelings toward discussions across the two condition, β (cr)=.0108, β (ctrl)=.002.

Figure A2. Students' math grade and their evaluation for productive collaboration in discussions.



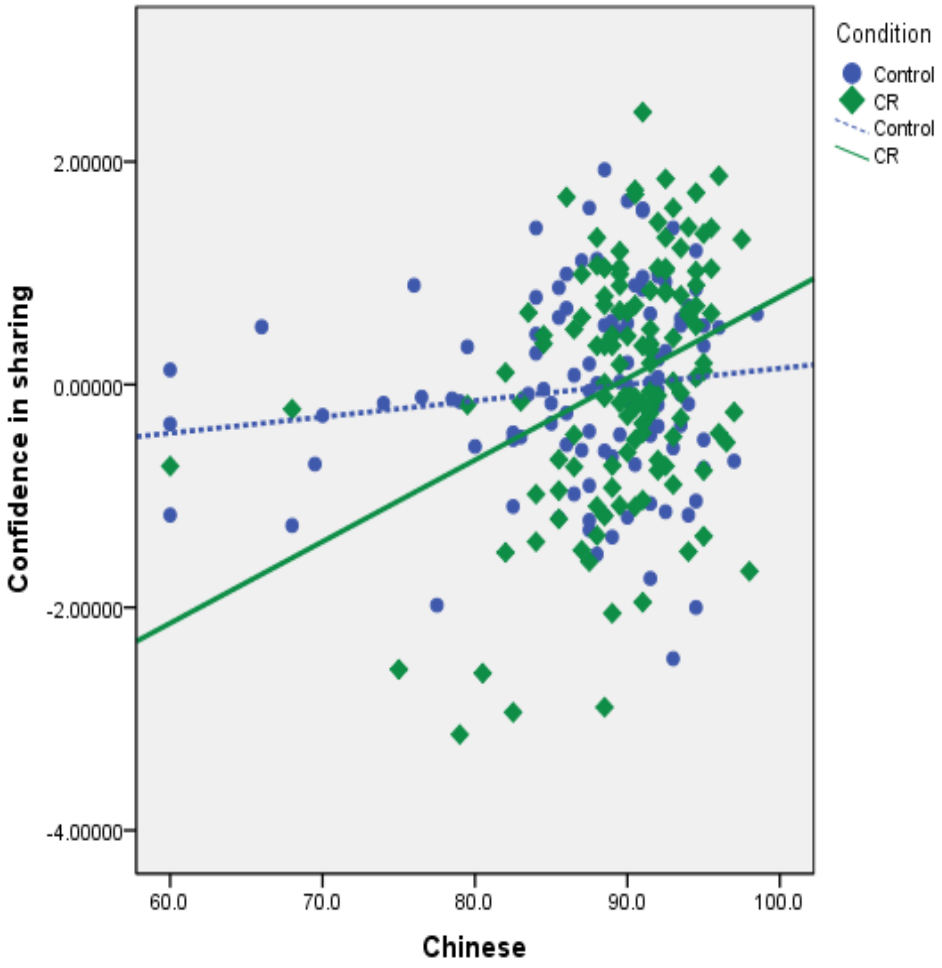
Note: All students' data are included and represented by the dots and diamonds in the figure. The slope of the fitting line is the regression coefficient of the linear relationship between students' math grade and their evaluation for productive collaboration in discussions across the two condition, β (cr)=.016, β (ctrl)=.03.

Figure A3. Students' pre-engagement in lessons and positive feelings towards CPS.



Note: All students' data are included and represented by the dots and diamonds in the figure. The slope of the fitting line is the regression coefficient of the linear relationship between students' pre-engagement in lessons and their positive feelings toward CPS across the two condition, β (cr)=.002, β (ctrl)=.008.

Figure A4. Students' Chinese grades and their confidence in sharing.



Note: All students' data are included and represented by the dots and diamonds in the figure. The slope of the fitting line is the regression coefficient of the linear relationship between students' math grade and their evaluation for productive collaboration in discussions across the two condition, β (cr)=.12, β (ctrl)=.016.

Table A1.

Results for principal factor analysis of pre-survey

	Factors		
	1 Active Engagement in Lessons	2 Favorable towards Group Work	3 Extroversion
B3	**.63**	-.01	-.05
B9	**.62**	-.04	.33
B4	**.61**	-.03	.12
B8	**.51**	.24	.01
B11	**.46**	.15	-.11
C8	**.38**	.15	.11
C1	**.37**	.33	.28
C4	**.37**	.11	.21
C11	-.07	**.65**	.04
C7	.29	**.50**	.15
B1	.24	**.49**	-.17
C6	-.02	**.47**	-.01
C10	.07	**.43**	-.00
C3	.05	**.43**	.15
B6	-.10	**.33**	.17
B5	.14	**.30**	.13
C12	.12	.24	-.11
B2	.05	**.**07	.06
B7	.17	-.11	**.58**
C2	.01	.30	**.54**
B12	.19	.04	**.54**
B10	.22	-.05	**.49**
C9	-.20	.13	**.49**
C5	.39	-.17	**-.40**
Explained variance (%)	20.12	13.09	8.13

Note. Items with factor loadings bigger than 0.3 are indicated in bold. Extraction Method: Principal Factor Analysis. Rotation Method: Varimax with Kaiser Normalization.

Table A2

Results for principal factor analysis of part A in post-survey

	Factors		
	Positive feeling towards discussion	Nice group dynamics	Productive collaboration
AA1	**.81**	-.09	.03
AA2	**.71**	-.07	.31
AA11	**.66**	-.05	-.05
AA5	**.57**	-.53	.01
AA3	**.52**	-.22	.25
AA7	-.06	**.73**	-.02
AA4	-.15	**.67**	-.15
AA6	-.05	**.63**	-.18
AA12	.33	**-.40**	-.16
AA10	.12	-.19	**.78**
AA9	-.15	.35	**.51**
AA8	.23	-.21	**.48**
Explained variance (%)	20.24	17.35	10.18

Note. Items with factor loadings bigger than 0.3 are indicated in bold. Extraction Method: Principal Factor Analysis. Rotation Method: Varimax with Kaiser Normalization.

Table A3

Results for principal factor analysis of part C in post-survey

	Factor		
	Comfortable group dynamics in CPS	Positive feeling towards CPS	Confidence in sharing
C5	**.731**	.022	.013
C4	**.729**	.110	.277
C7	**.715**	.104	.176
C6	**.639**	.149	-.214
C8	**.521**	.208	-.013
C12	**.493**	.459	.183
C3	.141	**.717**	.109
C1	.326	**.715**	.079
C11	.460	**.571**	.085
C9	.223	**-.507**	.244
C2	-.131	-.037	**.796**
C10	.225	.133	**.661**
Explained Variance (%)	24.65	16.05	**11.18**

Note. Items with high factor loadings are indicated in bold. Extraction Method: Principal Factor Analysis. Rotation Method: Varimax with Kaiser Normalization.

Table A4

The significant predictors for students' feelings towards CR and CPS

	Regression predicting feelings towards discussions and CPS					
Predictors	1st	2nd	3rd	4th	5th	6th
Chinese reading		.23***				.42***
Active engage-ment in lessons	.21***					.16*
Favorable towards group activity	.14**		.22**	.14*	.20**	
Extroversion		.12*	.18**	.27***		
CR vs No-CR	.37***		1.21***			-4.82***
Chinese*CR vs No-CR						4.8***
Math*CR vs No-CR			-1.07**			
Pre1*CR vs No-CR	-2.96**				-.18**	
R^2	.24	.06	.10	.08	.07	.16

*Note: *p < .05, **p < .01, **p < .001, blank means the predictor had no significant effect and was removed from the regression model*

Table A5

Distribution of Effective Leadership Moves and Total Leadership Moves

	Leadership			Allocating tasks			Proposing & Justifying solutions			Planning & Organizing			Seeking Consensus		
Group	TM	EM	%	TM	EM	%	TM	EM	%	TM	EM	%	TM	EM	%
Ms.Fang_1	45	37	82	6	6	100	23	21	91	13	10	77	3	1	33
Ms.Fang_10	49	32	65	4	1	25	27	19	70	16	11	69	2	2	100
Ms.Yang_3	32	28	88	1	0	0	22	21	95	9	8	89	0	0	
Ms.Yang_5	33	19	58	4	0	0	13	9	69	16	10	63	0	0	
Ms.Wei_1*	42	38	90	2	2	100	15	14	93	24	21	88	1	1	100
Ms.Wei_11*	49	48	98	1	1	100	32	31	97	15	14	93	1	1	100
Ms.Sun_1*	45	43	96	0	0		25	22	88	20	20	100	0	0	
Ms.Sun_5*	64	56	88	2	2	100	36	30	83	21	19	90	5	4	80

Note. EM= effective leadership moves; TM= total leadership moves; * are CR groups

Appendix B

Pre-Survey

A. Your Friends

A1. Who are your 5 best friends in the class? Please write their names below.

_____

A2. Who do you think have the most things to say during class discussions? Please write down less than 8 students' names.

_____

_____

A3. Who do you think usually have good ideas? Please write down less than 8 of your classmates' names.

_____

_____

A4. Who do you think are good leaders in the class? Please write down less than 8 of your classmates' names.

_____

_____

A5. Who do you think are very quite in your class? Please write down less than 8 of your classmates' names.

_____

_____

B. You and your classmates

How true are these statements to you? Put an **X** through your option.

1 is not at all true 4 is very true

B1. The kids in my class care a lot about other kids and try not to hurt their feelings.

B2. The kids in my class always listen to other kids when they are talking.

B3. I get called on a lot by my teacher to answer her questions.

B4. I like to answer my teacher's questions.

B5. It is easy for me to tell other people that I disagree with them.

B6. It's hard for me to accept others' ideas, especially when I do not agree with them.

B7. I often feel Lonely because my classmates ignore me.

B8. I often help my classmates when they have difficulty understanding the lessons.

B9. It's pretty easy for me to make friends.

B10. I'm more shy and quiet than other kids.

B11. When I am working or playing with my friends, I like to be the leader.

B12. I prefer to stay alone rather than to play together with other kids.

C. Your Class Activities

How true are these statements to you? Put an **X** through your option.

1 is not at all true 4 is very true

C1. In my class, I have many chances to work with my classmates in small groups.

C2. I'd rather study alone than to study together with my classmates.

C3. I think my class activities are boring.

C4. I want to have more small-group activities with my classmates.

C5. I always feel competitive pressure in my class.

C6. I think discussions in my classroom are very important.

C7. I think the discussions in my classroom are interesting.

C8. I love learning Chinese.

C9. We usually do not have many discussions in the Chinese classes.

C10. I love learning math.

C11. We usually do not have many discussions in the math classes.

C12. We could not have a good discussion without the teacher's help.

Appendix C

CPS Problems

Hi there! You and your group will discuss and solve several math problems in the following 15 minutes. Please remember that for each question, there will be more than one way of solutions! Your primary goal is to make sure **everyone** in the group understand how to solve the problem, and your secondary goal is to come up with **as many solutions as possible**! You will find these math problems very interesting!

1) Look at the number 2809 below, it is made up of 24 matches. Now given a chance to move only 2 of the matches, what is the biggest number you will get? And what about the smallest one?

2) (a) First solve this equation $(1-\frac{1}{5})\ x = 18$, then suppose you are going to explain division with frictions to your peers with this equation. You need to explain it by relating to the real world, for example, making a word problem. What would you say be a good story for the equation above?

   (b) Now if the equation has been changed to a mathematical expression $18 \div (1-\frac{1}{5})$, will you get the same answer as for question (a)?

3) Monk Tang plans to invite his 3 disciples to have dinner at his temple. He asks the young monk to divide the 19 steamed breads into 3 different serving sizes, and each size should be 1/2, 1/4, 1/5 of the total number of the steamed breads. Besides, none of the single steamed bread should be broken into halves. The young monk is so puzzled because 19 cannot be divided exactly by 2, 4 or 5. Could you please help the young monk solve the problem?

Appendix D

Final Survey: CR Version

A: How I Feel about Collaborative Reasoning (CR) Discussions (4,6,7 reversed)

How true are these statements to you? Put an X through your option.

1 not at all true 4 very true

A1: I enjoyed CR discussions.

A2: I think the stories for the discussions were very interesting.

A3: I learned how to listen to my classmates more carefully.

A4: I felt uncomfortable to work in my discussion group.

A5: I was able to state my ideas clearly in CR discussions.

A6: Sometimes I was eager to talk, but I couldn't get the chance to speak.

A7: I think my group didn't listen to me carefully.

A8: We considered different perspectives to achieve the best solutions.

A9: I tended to change my position when most people didn't agree with me.

A10: I trusted my discussion group members.

A11: Our discussions were exciting.

A12: I think CR discussions will help me to work with my classmates in a small group.

A13: In the future, I would like to have more CR discussions.

A14: Compared to our usual story discussions, I love CR discussions more.

C: How I Feel about the Math Group Work. (2 4 9 10)

How true are these statements to you? Put an X through your option.

1 not at all true 4 very true

C1: I enjoyed this kind of math group work.

C2: I think the math problems were very hard.

C3. I think the discussions in math group work helped me to understand the math concepts.

C4: I felt uncomfortable to work in the math group.

C5: My group cooperates very well on the math work.

C6: We had classmates led us well in doing the math group work.

C7: I could state my ideas freely in math group work.

C8: Compared to our usual math classroom activities, I love this math group work more.

C9: To make sure everyone in the group understood the problems is very challenging.

C10: I was not confident to share ideas in math group work because my math is not good.

C11: In the future, I hope to have more such kind of group work on math.

C12: I think I used some skills I learned from the CR discussion to work in the math group.

Appendix E
Final Survey: Control Version

A: How I feel about our story discussions in the Chinese classes for the past two weeks

How true are these statements to you? Please fill in the hollow circle of your option.

1 not at all true very true

A1: I enjoyed our classroom discussions.
A2: I think the questions for our discussions were very interesting.
A3: The discussions helped me listen to my classmates more carefully when they're talking.
A4: I felt uncomfortable to work in my discussion group.
A5: I was able to state my ideas freely in the discussions.
A6: Sometimes I was eager to talk, but I couldn't get the chance to speak.
A7: I think my classmates didn't listen to me carefully.
A8: We considered different perspectives for the discussion questions.
A9: I tended to change my position when most people didn't agree with me.
A10: I trusted my classmates.
A11: Our discussions were exciting.
A12: I think I learned how to discuss in a small group.

C: How I feel about the math group work.

How true are these statements to you? Please fill in the hollow circle of your option.

1 not at all true 4 very true

C1: I enjoyed this kind of math group work.
C2: I think the math problems were very hard.
C3. I think the discussions in math group work helped me to understand the math concepts.
C4: I felt uncomfortable to work in the math group.
C5: My math group cooperated very well.
C6: We had classmates led us well in doing the math group work.
C7: I could state my ideas freely in the math group work.
C8: Compared to our usual math classroom activities, I love this math group work more.
C9: To make sure everyone in the group understood the problems is very challenging.
C10: I was not confident to share ideas in math group work because my math is not good.
C11: In the future, I hope to have more such kind of group work on math.
C12: I think I used some skills I learned from my classroom discussions to work in the math group.