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Creative problem-finding ability (CPFA) is an important component of creativity, but research into it has just started and results so far could not offer much guidance to teaching. This study utilized a 2 (teaching materials or tasks of different difficulty: high and low) × 3 (group member construction: homogeneous group, heterogeneous group, and voluntary group) between subjects design to examine how the group member construction affected student's peer interaction, and then affected creative problem-finding ability during a long-term classroom teaching process. Before the experiment, 217 5th-grade students (108 boys, 109 girls) in 4 classes were randomly chosen from 1 primary school in China to take the CPFA Test and then, according to the score on this, 188 students were chosen and matched into 6 equal groups. All of the participants in 6 groups received 16 classes of a thinking intervention program in 16 weeks and did the CPFA Test and Peer Interaction Ability Test after the experiment. The results showed that: (a) Teaching materials (or tasks) of different difficulty had no significant impact on improving students' creative problem-finding ability, (b) group member construction had a significant influence on students' peer interaction and CPFA, (c) Students of different initial CPFA in different groups had a significant difference on their peer interactive level and improvement of their CPFA, and (d) peer interaction had a positive correlation with students' CPFA.

Problem finding, as an important component of creativity (Chand & Runco, 1993; Wakefield, 1985), has received a great deal of attention from researchers in the field of psychology and education. Because of the different concentration of the research, definitions of *problem finding* have shown a variety of points of view. Some researchers thought that problem finding is one kind of cognitive strategy, and they defined problem finding as a kind of effective learning method (Graesser, 1992; Torres, 1998), a valid form of cognitive development (Kelley & Sigel, 1986), or a process of cognition (Rosenshine, Meister, & Chapman, 1996). Prudence and Jesus (2001) defined problem finding as a change of behavior, which can bring individuals' internal change beyond the behavior change itself. In the present

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context, problem finding is a thinking activity that utilizes existing contexts and experience to produce and express newfound questions according to certain purposes. These kinds of activities include not only thinking processes, but also thinking products; not only cognitive strategy, but also metacognition; not only behavior change, but also ungratified emotional state.

Enhance the development of students' problem finding, we should not only pay attention to the quantity of problems they pose, but also to their diversity (Yoshioka et al., 2005), quality (Kalady, Elikkottil, & Das, 2010), and most importantly to their creativity (Hu, Adey, Shen, & Lin, 2004; Hu, Shi, Han, Wang, & Andy, 2010; Paletz & Peng, 2009). In this study, creative problem-finding ability (CPFA) is defined as a kind of intellectual trait or ability that is demonstrated in the process of producing and expressing new-found questions in a unique, novel and useful and purposeful way, using existing contexts and experience. CPFA is embodied not only in the quantity, but also in the diversification (types) and in the originality of the problems found.

The factors that influence students' creative problem finding can be divided into three types: circumstantial factors, factors in the students themselves and peer-interaction factors. First of all, school and family are two main circumstantial factors that influence students' problem finding ability. Since this study focuses on the impact of classroom interaction on students' CPFA, only the school factors will be summarized here. School factors includes: (1) evaluation systems and school systems: Niu and Sternberg (2003) found that school pedagogic practices and educational testing systems could influence students' creativity. Yuan (1999) who previously was the deputy director of the normal education department of Ministry of Education has said that the traditional measurement standard of successful education in China would be to make all students who had questions have no question through education, and to make students understand everything. In contrast, the measurement standard in America could be said to make students who had no question have questions, and it would be highly rated if a teacher could not answer questions asked by students. Thus as students grow up, Chinese students tend to ask fewer and fewer questions, while most American students ask more and more questions and thus perhaps become more creative. (2) The teacher; the teacher is the cooperator, facilitator and participator during students' learning process. He or she can improve the development of students' creative problem finding (Lowrie, 2002), but also can be a barrier to the development of students' creativity problem finding because of the teacher's own unreasonable knowledge structure (Edwards & Bowman, 1996), negative attitude to students' problem finding (Ciardiello, 1993; Karabenick & Sharma,1994) and inappropriate teaching method (Meij, 1988).

Second, the students' store of knowledge (Fuhrer, 1989; Meij, 1990; Smith, Tykodi, & Mynatt, 1988), metacognition (Kaberman & Dori, 2009; Yarrow & Topping, 2001), emotion (Amabile, Barsade, Mueller, & Staw, 2005; George & Zhou, 2002; Hu & Wang, 2010), personality (Qian, Plucker, & Shen, 2010; Selby, Shaw, & Houtz, 2005; Tardif & Sternberg, 1988) and so on can also influence their CPFA.

Last, but not least important, the peer interaction is another important factor affecting students' problem finding ability through the style of questions and skill of a feedback provider (Webb, 1982). One study conducted by King, Staffieri, and Adelgais (1998) showed that peer interaction not only could promote students to ask more high quality questions, but also could facilitate students' knowledge construction. Vincent and Ley (1999) stated that peer tutors could effectively model study skills such as concentrating on the material, organizing work habits, and asking questions.

Peer interaction, as one of the main forms of classroom interaction, plays an important role in group learning. Studies have indicated that group learning could improve students' development of critical thinking (Baloche, 1994; Guiller, Durndell, & Ross, 2008) and cognitive skills (Anderson, Howe, Soden, Halliday, Low, 2001; Schwartz, Neuman, Gil, & Ilya, 2003), but how the group members are matched (group construction: heterogeneous and homogeneous groups) makes a great impact on students. It can be summarized into two kinds of views: One view supported the idea that students in heterogeneous group had a better learning effect, and the other one supported that students in homogeneous group did better. Research has suggested that heterogeneous grouping was of benefit to group members to complete learning tasks (Harpaz & Lefstein, 2000); low-ability students would be better in heterogeneous group where they could get benefit from high-ability students and improve their achievements (Kang, 2007).

However, there were also researches that come to a different conclusion. King et al.'s (1998) research showed that peers of the same ability could provide the scaffolding for higher-level thinking and learning of other peers. Battistisch, Solomon, and Delucchi (1993) and Good, Mulryan, and McCaslin (1992) found that students would not interact or develop their mathematics thinking if they were at different positions or group members were of different abilities. Ke (2004) found that a heterogeneous group and a homogeneous-high-score group did not do well in cooperative problem solving, whereas a homogeneous-low-score group did well in cooperative problem solving.

Thus, it can be seen that group construction can influence the peer interaction, and then influence group members' creative problem-solving and thinking ability. But we found a strange phenomenon in China that, in current classroom teaching, despite the fact that most teachers recognize the importance of peer interaction, when they organize interactive learning, the distribution of group members was aimless and optional. So it may be important to find out how group construction influences peer interaction, as well as if peer interaction can influence creative problem finding and how. Currently studies on peer interaction mainly focus on the impact of autonomous groups on students' socialization or the effect of an organized group (i.e., a class) on individuals, and studies of the influence of learning group on individuals' learning and ability are relatively few. In classroom teaching, there is a lack of studies into how to assign students to groups and how the group member construction influences students' creativity or problem finding ability.

The purpose of this study was to explore a long-term classroom teaching process, involving teaching materials (or tasks) of different difficulty, how the group member construction affected student's peer interaction, and then affected CPFA and if there was different performance on peer interaction and CPFA among students of different initial CPFA.

The hypotheses were as follows:

1. Teaching materials (or tasks) of different difficulty had a significant impact on improving students' CPFA.
2. Group member construction had a significant influence on students' peer interaction and CPFA.
3. Students of different initial CPFA in different groups had a significant difference on their peer interactive level and improvement of their CPFA.

METHOD

Design

This study utilized a 2 (teaching materials or tasks of different difficulty: higher difficulty and lower difficulty) $\times$ 3 (group member construction: homogeneous group that has students of similar ability, heterogeneous group that has students of mixed ability, and voluntary group that chose their own group members voluntarily) between-subject design. To assure the reliability and validity of the results, some variables were controlled: (a) teaching content and order. They were chosen from "Learn to Think" (LTT) Activity Curriculum (Hu et al., 2011). There were 16 tasks in which the difficulty of 8 tasks were higher and the difficulty of other tasks were lower. Each higher-difficulty activity corresponded to one lower difficulty task and they trained same thinking method. All the participants received tasks that with the same sequence of thinking method; (b) teacher factors. There were two teachers. They took part in designing the LTT Activity Curriculum and had same age, sex, teaching experience, and teaching ability. One teacher was in charge of the teaching of higher-difficulty activities and the other was in charge of the teaching of lower-difficulty activities; and (c) participant factors. Six equal group students had been formed.

Participants

Before the experiment, 217 grade-5 students (108 boys, 109 girls) in four classes were randomly chosen from one primary school in China, and completed the CPFA Test. Among them, the oldest was 12, the youngest was 9, and their average age was 10.3. To get six equal group students, and considering the schools' regular teaching arrangement, the participants were selected according to the following rules: (a) There must be no significant difference in participants' mean CPFA among the six groups; (b) numbers of boys and girls in each group should be as equal as possible; (c) to guard against statistical regression, if a student's score on the CPFA Test was lower than 25 or higher than 95, they were omitted; and (d) the selection of participants in each group was made on the basis of their levels of achievement in their former classes. Finally, 188 students took part in the class teaching experiment. The matching conditions of participants are shown in Table 1.

To make sure the students' CPFA among the six groups were almost at the same level before the experiment, multiple comparisons were conducted. The results of these comparisons are in the following (see 'Pretest scores').

Measures

Primary school students' CPFA test The test was revised from Creative Scientific Problem Finding Test (Hu etc., 2010). It consists of 4 open-ended questions and was presented as PowerPoint slides.

Slide 1 (instruction): "The ability to ask creative questions is a very important one. Today you have an opportunity to put your creativity to work. Please try to come up with as many questions as you can, from as many angles as you can, and try to produce as unique questions as you can."

Slide 2 (open situation): "Based on your life experiences and daily observations of things, write down all questions you are curious about."

Slide 3 (literature situation: read a fairy tale on The Small Frog Observing Night Sky): "If you were

TABLE 1
General Condition of the Six Groups' Participants and Their Pretest Scores

Group		*n*	*M*	*SD*
1	Boy	17	48.94	14.35
	Girl	15	54.93	20.67
	Total	32	51.75	17.56
2	Boy	13	51.08	20.23
	Girl	15	54.33	14.05
	Total	28	52.82	16.94
3	Boy	16	52.88	15.17
	Girl	16	42.25	8.83
	Total	32	47.56	13.35
4	Boy	20	48.80	14.91
	Girl	12	46.25	12.23
	Total	32	47.84	13.81
5	Boy	15	53.80	18.69
	Girl	17	51.47	12.24
	Total	32	52.56	15.38
6	Boy	15	54.00	16.74
	Girl	17	51.18	13.97
	Total	32	52.50	15.14

Note. Respectively, 1–6 stand for voluntary group with the teaching material (or tasks) of high difficulty, voluntary group with the teaching material (or tasks) of low difficulty, homogeneous group with the teaching material (or tasks) of high difficulty, homogeneous group with the teaching material (or tasks) of low difficulty, heterogeneous group with the teaching material (or tasks) of high difficulty, and heterogeneous group with the teaching material (or tasks) of low difficulty (the same below). Four students made up one subgroup.

the master of the story, what kinds of questions can you raise?

Slide 4 (mathematics situation: shows a picture included 12 tricycles and 18 bicycles): "Based on the picture, please ask as many questions as you can"

Slide 5 (science situation: shows an astronaut standing on the moon):"This picture contains many science related questions, write down as many as you can think of."

Cronbach's alpha reliability coefficient of the whole test was .85, and the Pearson's correlation coefficient between the scorers was .86. Item analysis revealed that it had moderate difficulty and good discrimination. Confirmatory factor analysis showed that Adjusted Goodness of Fit Index = .93, Nonnormed Fit Index (NNFI) = .98, Comparative Fit Index (CFI) = .99, Root Mean Square Error of Approximation (RMSEA) = .065. These suggest that test has high reliability and good construct validity.

Peer interaction questionnaire (Han, 2008). This self-report questionnaire includes 20 items. It can be divided into four dimensions and employed a 6-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). The subtests and sample items are illustrated in Table 2.

TABLE 2
The Subtests and Sample Items of the Peer Interaction Questionnaire

Name of Subtest	*No. of Items*	*Sample Item*
Affective interaction	5	I think the members of our group don't like me at all.
Group cohesion	5	Our group discussion is always heated.
Thinking interaction	5	The classmates' views can make me think up ideas more uniquely.
Attitude to group	5	As a member of our group, I feel very proud.

Cronbach's alpha reliability coefficient of the whole test was .852, and subtests' α coefficients were from the lowest .628 to the highest .756. Confirmatory factor analysis showed that the fit index for 4 factors was very good (Normed Fit Index [NFI], CFI, Incremental Fit Index [IFI], Goodness of Fit Index [GFI], and NNFI > .90, RMSEA = .041 < .08[1]). These suggest that the questionnaire has high reliability and good construct validity.

Teaching Materials

The LTT curriculum, designed by Weiping Hu, can promote students' thinking ability, academic achievement, learning strategies, motivation and so on (for a detailed description of the curriculum, see Hu et al., 2011). This research chose some activities from the curriculum as the teaching materials. Because thinking methods was not considered as the main variable in this research, it was controlled here. The thinking program's theme taught in the teaching of different difficulty was the same, but the difficulties of the program were distinguished. The comparison of part of the teaching materials (or tasks) of different difficulty was presented in Table 3.

Procedure

There were three research stages in this study: The first stage was the preparing stage of the experiment. First, 217 fifth-grade students in four classes were randomly chosen, and did the CPFA Test. Then, according to their pretest scores, 188 students were chosen as participants, and were divided into six equal groups. Finally in this first stage, teaching materials (or tasks) of different difficulty were chosen. The second stage was the

[1]The NFI, CFI, IFI, GFI, and NNFI should be larger than 0.9. The RMSEA should be under 0.08.

TABLE 3
Comparison of teaching Materials (Or Tasks) of Different Difficulty

Theme of Thinking Program	*High Difficulty*	*Low Difficulty*
Classification	To classify the solid figure and grasp the classification standards' Multi-dimensions and multiple levels.	To classify the familiar things, figures and daily school things.
Breaking through thinking set	To break through various things' traditional function. To summarize the function of thinking breakthrough and do lots of transfer exercises.	To break through single common object's traditional function and several objects' habit set.
Redefinition	To redefine things synoptically based on their functions. To generalize and abstract several things' common properties, and generalize the features of abstract things.	To extract the titles of articles accurately and grasp things' main function to create. To generalize several things' common perceptual properties, and define things by grasp their main features and functions.
Problem finding	To find problems in complex things from all aspects and then on the basis of classification to ask questions in depth.	To find problems to the simple things from all aspects and in depth, and try to ask as many. scientific questions as possible about daily life
	To put developmental questions to things from the past perspective and future perspective.	To put questions about the properties of the same kind common things.
Comparison	To look for the similarities among many kinds of different things and among their properties.	To look for similarities and differentiate between two objects.
Story inventing	To image elaborately and make stories in multi-levels. To make a story under a "no valid reason" situation.	To add an ending to the story. To make stories with some things which are chosen from a given set.

stage of the teaching experiment. First, the new class was set up according to the rules; then every group received a 16-lesson thinking intervention program according to the experiment plan. The third stage was the testing stage. After the teaching experiment, the participants were tested for their peer interaction level and CPFA.

RESULTS

Pretest Scores: Comparison of CPFA Scores Among Six Groups

No significant differences were found among the six groups' CPFA scores (Table 4) indicating that before the experiment the CPFA ability of six groups were almost at the same level.

Posttest Scores

Influence of teaching materials (or tasks) of different difficulty and group member construction on improvement of students' CPFA.

ANOVA was used to test the main effect and interaction effect of teaching materials of different difficulty (2) and group member construction (3) on CPFA gain scores (posttest score–pretest score).

There was a significant difference on the main effect of group member construction on CPFA gain scores ($F_{(2,\ 186)} = 22.07$, $p < .001$, partial $\eta^2 = .197$), but there was no significant difference on the main effect of teaching materials of different difficulty ($F_{(1,\ 186)} = 0.63$,

TABLE 4
Comparisons of the Creative Problem-Finding Ability Scores Among six Groups

(I) Group	*(J) Group*	*Mean Difference (I–J)*	*p*
1	2	−0.768	0.848
	3	4.375	0.258
	4	4.412	0.262
	5	−0.698	0.857
	6	−0.651	0.866
2	1	0.768	0.848
	3	5.143	0.199
	4	5.180	0.203
	5	0.070	0.986
	6	0.117	0.977
3	1	−4.375	0.258
	2	−5.143	0.199
	4	0.038	0.992
	5	−5.073	0.190
	6	−5.026	0.194
4	1	−4.412	0.262
	2	−5.180	0.203
	3	−0.038	0.992
	5	−5.110	0.194
	6	−5.063	0.198
5	1	0.698	0.857
	2	−0.070	0.986
	3	5.073	0.190
	4	5.110	0.194
	6	0.047	0.990
6	1	0.651	0.866
	2	−0.117	0.977
	3	5.026	0.194
	4	5.063	0.198
	5	−0.047	0.990

$p > .05$, partial $\eta^2 = .003$) and interaction effect of group member construction and teaching materials of different difficulty ($F_{(2, 186)} = 2.31$, $p > .05$, partial $\eta^2 = .025$). This results indicated that during the long-time training, group member construction had an impact on the improvement of students' CPFA ability significantly, and teaching materials of different difficulty and the interaction of teaching materials of different difficulty and group member construction had no significant impact on the improvement of students' CPFA ability.

Influence of group member construction on improvement of students' CPFA. ANOVA was used to test the difference of the improvement of students' CPFA among different groups, and the voluntary group students' CPFA gain scores were significantly higher than the homogeneous group and heterogeneous group ($F_{(2, 186)} = 21.35$, $p < .001$, partial $\eta^2 = .189$), and there was no significant difference between the homogeneous group and heterogeneous group.

To further explore if the group construction had different impacts on the CPFA of students of different initial CPFA levels, the students in every group were divided into three ability levels (high ability, medium ability and low ability) according to their pre-test scores of the CPFA test.

Table 5 and Figure 1 showed that in all three ability levels, the improvements of CPFA of students in the voluntary group are significantly higher than the students in homogeneous and heterogeneous groups ($p < .05$); the improvement of CPFA of students of high ability and medium ability have no significant difference between homogeneous group and heterogeneous group, whereas the improvement of CPFA of students of low ability in homogeneous group are lower than heterogeneous group ($p < .01$).

Influence of group member construction on students' peer interaction level. The results showed that group member construction had a significant impact on the improvements of students' CPFA, and there was a significant difference in the improvement of CPFA among the students of same ability in different groups. To explore the underlying causes of that, the peer interaction level of different initial CPFA students in different groups were analysed.

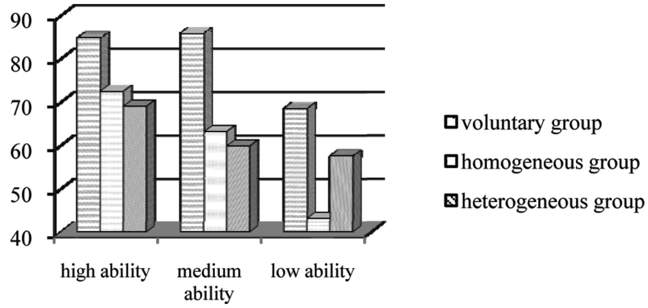

FIGURE 1 Creative Problem-Finding Ability gain scores of students of different initial ability levels in different group member construction.

The peer interaction level of different initial ability students in different groups. Table 6 showed the subtest and total scores of peer interaction of students of different ability in every group.

Influence of group member construction and ability level on students' peer interaction. Table 6 indicates that the interactions of students of different ability in different groups were different. MANOVA was used to test the main effect and interaction of group member construction (3) and ability level (3) on students' peer interaction, and significant differences were found in the main effect of group member construction (Wilks' lambda = .79, $F_{(8, 348)} = 5.42$, $p < .001$, partial $\eta^2 = .111$), the main effect of ability level (Wilks' lambda = .68, $F_{(8, 348)} = 9.43$, $p < .001$, partial $\eta^2 = .178$), and the interaction of group member construction and ability level (Wilks' lambda = .85, $F_{(16, 532)} = 1.86$, $p < .05$, partial

TABLE 5
Comparison of Scores of Students of Different Initial Ability Levels

Ability Level	*Group Construction*	*n*	*ΔM*	*SD*	*F*	*Partial η^2*	*Multicomparison*
High ability	Voluntary group	19	84.84	15.44	6.137**		1 > 2*, 1 > 3***
	Homogeneous group	20	72.50	12.24		.180	
	Heterogeneous group	20	69.05	16.28			
Medium ability	Voluntary group	22	85.91	18.28	11.246***		1 > 2***, 1 > 3***
	Homogeneous group	23	63.22	14.17		.260	
	Heterogeneous group	22	59.86	25.65			
Low ability	Voluntary group	19	68.58	18.26	13.824***		1 > 2***, 1 > 3* 2 < 3**
	Homogeneous group	20	43.15	14.34		.327	
	Heterogeneous group	21	57.52	12.64			

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

TABLE 6
The Peer Interaction Scores of Students in Every Group

	Affective Interaction		*Group Cohesion*		*Thinking Interaction*		*Attitude to Group*		*Total*	
Group	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
High ability										
Voluntary	25.53	4.26	25.79	3.94	26.00	3.21	25.74	4.00	103.05	13.10
Homogeneous	26.20	3.11	26.75	1.55	23.95	3.47	25.40	2.70	102.30	9.25
Heterogeneous	25.25	3.31	24.80	3.59	22.80	2.12	22.60	3.94	95.45	9.82
Medium ability										
Voluntary	25.05	3.30	25.41	3.57	25.09	2.69	24.82	4.08	100.36	7.95
Homogeneous	24.39	3.17	24.17	3.80	23.17	1.99	23.91	3.30	95.65	10.13
Heterogeneous	22.68	2.98	23.82	3.20	21.09	2.71	23.00	3.52	90.59	9.90
Low ability										
Voluntary	22.21	2.84	23.05	3.54	23.47	1.81	21.89	3.57	90.63	8.97
Homogeneous	19.55	3.71	19.25	2.84	19.90	3.01	19.35	3.44	78.05	9.60
Heterogeneous	21.57	4.62	21.24	3.03	21.76	2.79	20.33	4.56	84.90	12.24

TABLE 7
MANOVA of Group Member Construction and Ability Level on Peer Interaction

Variation Source	*Dependent Variable*	*SS*	*df*	*MS*	*F*	*p*	*Partial* η^2
Group member construction	Thinking interaction	310.968	2	155.484	21.510	0.000	.196
	Affective interaction	40.837	2	20.418	1.652	0.195	.018
	Group cohesion	81.063	2	40.531	3.712	0.026	.040
	Attitude to group	145.445	2	72.723	5.272	0.006	.056
	total	1993.535	2	996.767	9.595	0.000	.098
Ability level	Thinking interaction	192.359	2	96.179	13.306	0.000	.131
	Affective interaction	634.041	2	317.020	25.644	0.000	.225
	Group cohesion	671.920	2	335.960	30.771	0.000	.258
	Attitude to group	568.948	2	284.474	20.624	0.000	.189
	total	7798.987	2	3899.494	37.538	0.000	.298
Group member construction × Ability level	Thinking interaction	90.522	4	22.630	3.131	0.016	.066
	Affective interaction	108.823	4	27.206	2.201	0.071	.047
	Group cohesion	129.189	4	32.297	2.958	0.021	.063
	Attitude to group	75.560	4	18.890	1.370	0.246	.030
	total	1298.509	4	324.627	3.125	0.016	.066

$\eta^2 = .041$). To further explore the effects of group member construction and ability level on students' peer interaction, an analysis of variance was run. Results are presented in Table 7.

There were significant main effects of group member construction on thinking interaction ($p < .001$), group cohesion ($p < .05$), attitude to group ($p < .01$), and total ($p < .001$), and no significant main effects were found on affective interaction; there were significant main effects of ability level on peer interaction of all dimensions and total ($p < .001$). There were significant interaction effects of group member construction and ability level on thinking interaction ($p < .05$), group cohesion ($p < .05$) and total ($p < .05$), and no significant interaction effects were found on affective interaction and attitude to group.

As stated, there was no significant interaction effect on affective interaction, the LSD was done to examine the difference among three groups. The results are presented in Figure 2.

There was a significant difference on affective interaction of students of medium ability between voluntary group and heterogeneous group ($p < .05$); there was

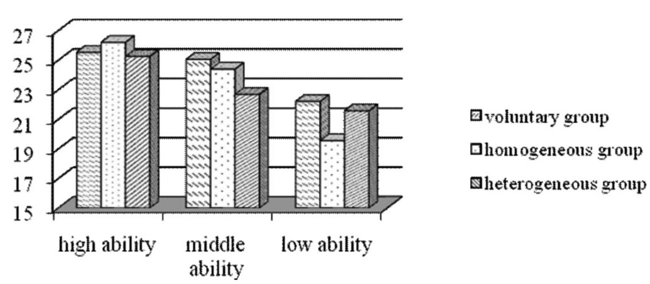

FIGURE 2 Affective Interaction Scores of Students of Different Ability Level in Different Groups.

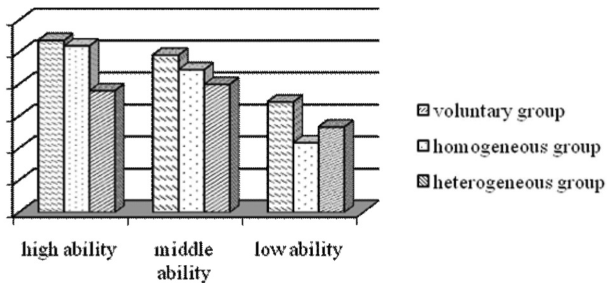

FIGURE 3 Attitude to Group Score of Students of Different Ability Level in Different Groups.

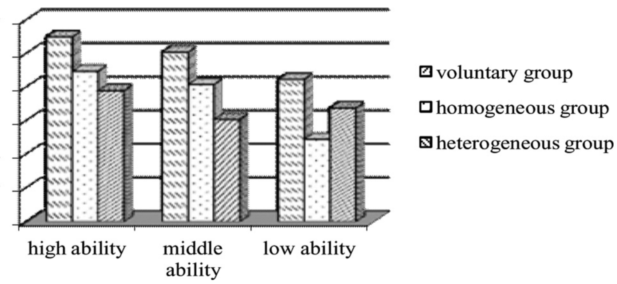

FIGURE 5 Group Cohesion Score of Students of Different Ability Level in Different Groups.

a significant difference on affective interaction of students of low ability between voluntary group and homogeneous group ($p < .05$); there was no significant difference on affective interaction of every ability level between other groups.

There was no significant interaction effect on attitude to group, and the LSD was done to examine the difference among three groups. The results are presented in Figure 3.

There was significant difference on attitude to group of students of high ability between voluntary group and heterogeneous group ($p < .01$), as well as between homogeneous group and heterogeneous group ($p < .05$); there was significant difference on attitude to group of students of low ability between voluntary group and homogeneous group ($p < .05$). There was no significant difference on attitude to group of students of medium ability among 3 groups.

There were significant interaction effects of group member construction and ability level on thinking interaction, group cohesion and total, so the simple effect test were done and the figures of thinking interaction score, group cohesion score and total score of students of different ability in three groups were presented in Figure 4, Figure 5, and Figure 6.

Figures 4–6 indicate that students of same ability level had different interaction quality in different groups. On the whole, students of medium and high ability had a higher interaction level than low-ability students. The simple effect of all ability students' thinking interaction was significant in the voluntary group ($F_{(2,60)} = 3.71$, $p < .05$, partial $\eta^2 = .136$) and the homogeneous group ($F_{(2,63)} = 10.34$, $p < .001$, partial $\eta^2 = .277$). The simple effect of all ability students' group cohesion was significant in the voluntary group ($F_{(2,60)} = 3.95$, $p < .05$, partial $\eta^2 = .098$), the homogeneous group ($F_{(2,63)} = 25.82$, $p < .001$, partial $\eta^2 = .530$), and the heterogeneous group ($F_{(2,63)} = 6.27$, $p < .01$, partial $\eta^2 = .179$). The simple effect of every ability students' total interaction level was significant in voluntary group ($F_{(2,60)} = 7.51$, $p < .001$, partial $\eta^2 = .218$), homogeneous group ($F_{(2,63)} = 27.62$, $p < .001$, partial $\eta^2 = .529$), and heterogeneous group ($F_{(2,63)} = 5.16$, $p < .01$, partial $\eta^2 = .142$).

The simple effect of group member construction was significant on thinking interaction of students of high ability ($F_{(2,\ 59)} = 5.95$, $p < .01$, partial $\eta^2 = .169$), medium ability ($F_{(2,\ 67)} = 10.71$, $p < .001$, partial $\eta^2 = .309$), and low ability ($F_{(2,60)} = 7.86$, $p < .001$, partial $\eta^2 = .244$). Simple effect of group member construction was significant on group cohesion of students of low ability ($F_{(2,60)} = 5.21$, $p < .01$, partial $\eta^2 = .201$); simple effect of group construction was significant on whole interaction of students of medium ability ($F_{(2,67)} = 3.59$,

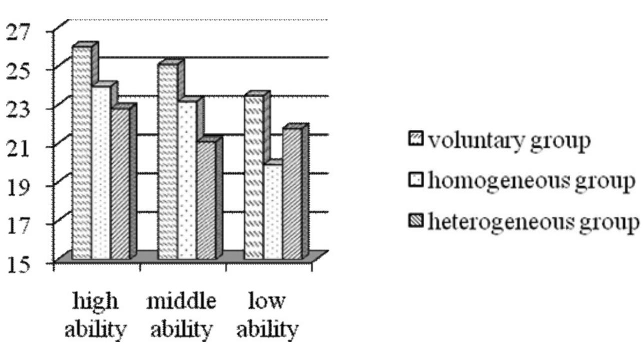

FIGURE 4 Thinking Interaction Score of Students of Different Ability Level in Different Groups.

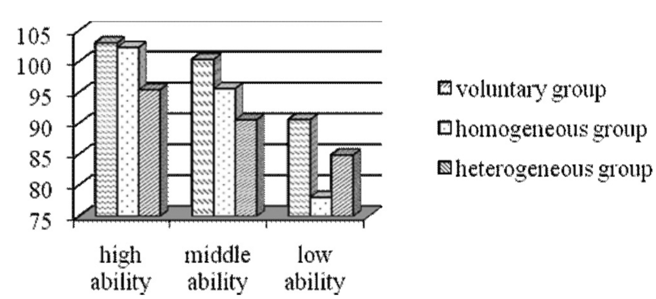

FIGURE 6 Total Interaction Score of Students of Different Ability Level in Different Groups.

TABLE 8
Correlation of Peer Interaction and Creative Problem-Finding Ability in Different Ability Levels

	n	ΔM	*Thinking Interaction*	*Affection Interaction*	*Group Cohesion*	*Attitude to Group*	*Interaction Total Score*
High ability							
Voluntary group	19	84.84	0.40	0.14	0.36	0.29	0.34
Homogeneous group	20	72.50	0.23	0.15	0.02	0.06	0.16
Heterogeneous group	20	69.05	0.64**	0.12	0.51*	0.79***	0.68***
Medium ability							
Voluntary group	22	85.91	0.33	0.46*	0.11	0.52*	0.40
Homogeneous group	23	63.22	0.67***	0.55**	0.61**	0.52*	0.70***
Heterogeneous group	22	59.86	0.42	0.15	0.54**	0.12	0.37
Low ability							
Voluntary group	19	68.58	0.65**	0.32	0.70***	0.48*	0.70***
Homogeneous group	20	43.15	0.58**	0.59**	0.69***	0.24	0.70***
Heterogeneous group	21	57.52	0.71***	0.44*	0.81***	0.32	0.65***

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

$p < .05$, partial $\eta^2 = .157$) and low ability ($F_{(2,60)} = 5.68$, $p < .01$, partial $\eta^2 = .200$).

Relationship between peer interaction and improvement of students' CPFA. The improvement of students' CPFA in different groups was different, and students' interaction in different groups was different, too. So the relationship between peer interaction and improvement of their CPFA was calculated, and high correlations between interaction (thinking interaction, affection interaction, group cohesion, attitude to group, and interaction total score) and improvement of students' CPFA were found: $r = .629$, $r = .389$, $r = .583$, $r = .405$, $r = .596$, respectively.

Table 8 indicates that the relationship between interaction and improvement of CPFA of students of different ability levels was different, and students of same ability had different interaction level in different groups. Specifically, this was reflected thus: (a) in the 3 group $\times$ 5 interaction dimensionality matrix, where 12 related coefficients reached a significant level at .05 in low-ability students, 8 in medium-ability students, and 4 in high-ability students. This result indicated that the influences of peer interaction to low- and medium-ability students were larger than high-ability students; and (b) the significant correlation of the high-ability students was mainly concentrated on heterogeneous group and of medium-ability students on homogeneous group, whereas significant correlation of low-ability students were evenly distributed over every dimensions.

DISCUSSION

Influence of Group Construction on Students' CPFA

Results showed that the group member construction had significant influence on the students' CPFA. The improvement of voluntary group students' CPFA was significantly higher than the homogeneous group or the heterogeneous group, and there was no significant difference between homogeneous and heterogeneous groups. In addition, Han (2008) found that in the task of low difficulty, the CPFA of students in homogeneous group was significantly higher than students in heterogeneous group. Explanations for the findings could be as following: First, the high level of group interaction is beneficial for CPFA. This study had showed that there was significant positive correlation between students' CPFA and interaction of all dimensions. Previous theories and empirical research also had indicated that peer interaction had a positive influence on the quality of students' academic achievement and ability, in which the extent of interaction quality was the core influencing factor. Saleh, Lazonder, and Jong (2005) proved that homogeneous groups used relatively more collaborative elaborations. In this study, peer interaction consists of affective interaction, thinking interaction, group cohesion, and attitude to group. The voluntary group students had a higher affective interaction because of their deeper emotional foundation developed from years of friendship; students of the voluntary and homogeneous groups had similar knowledge base and thinking ability, and a high level of cognitive conflict could emerge during group discussion, which would stimulate their positive thinking and produce higher thinking interaction; students in voluntary and homogeneous groups, especially in voluntary group, had similar purpose and interests, a good emotional foundation, greater cooperative intensions and sense of belonging, and the same goals, and cared for each other; they thus formed higher group cohesion and positive attitudes to the group.

Second, positive emotional state of students is good for CPFA. Hu and Wang (2010) found that a positive emotional state could improve students' creative scientific problem-finding ability, especially on the dimension of fluency and flexibility; different negative emotional states brought a different impact on creative scientific problem-finding ability. Neither sadness nor anger influenced the students' creative scientific problem-finding ability, but fear had a significant adverse effect on this ability. In the voluntary and homogeneous groups, especially in the former, students had positive emotion, and each member was actively involved in discussion, so the atmosphere was exciting. However, students in the heterogeneous group were opposite, so the discussion atmosphere in each group may be depressing.

Third, open environment of groups is useful to CPFA. Although teachers set up an open teaching environment, students eventually had to complete the task in the group interaction, thus the group environment was very important to students. Research showed that the environment influenced the development of students' creativity. Torrance (1962) considered that prohibition of doubts and questions, making himself (or herself) consistent with others, intolerance of students' playfulness and so on, could restrain the development of students' creativity. It was easier for the voluntary group to create an open and harmonious environment that could enhance their CPFA, because they had the relatively deeper emotional base, could ask questions boldly, and could express their unique ideas and tolerate peers' playfulness.

Influence of Group Construction on Different Initial Ability Students' CPFA

Results showed that the improvement of different initial ability students' CPFA in different groups was different. For the medium- and high-ability students, CPFA gain scores of the voluntary group were significantly higher than those of homogeneous and heterogeneous groups, and gain scores of homogeneous group were higher than heterogeneous group, although the difference were not significant; for low-ability students, CPFA gain scores of the voluntary group were significantly higher than those of homogeneous and heterogeneous groups, and gain scores of heterogeneous group were significantly higher than homogeneous group. This result was in accordance with one meta-analyses of research, which found that low-ability students performed better in heterogeneous, as opposed to homogeneous, groups; medium-ability students performed better in homogeneous groups; and high-ability students performed equally well in either type of group (Lou et al., 1996; Saleh et al., 2005; Wilkinsona & Fungb, 2002). In other words, it was better for high- and medium-ability students to study in voluntary and homogeneous groups, but low-ability students would have a better development in a heterogeneous group.

The reasons may be that, on the one hand, the high- and medium-ability students with rich knowledge and problem-finding strategies could provide the scaffolding for higher-level thinking and learning of other voluntary and homogeneous group members (King et al., 1998). Meanwhile, the students of middle- and high-ability influenced problem-finding strategies of low-ability students. Some researchers argued that problem finding was one of cognitive strategies and metacognitive strategies (Torres, 1998; Rosenshine et al., 1996). Medium- and high-ability students had the higher thinking ability and problem-finding ability, and in the discussion, their strategies and methods of asking, analyzing, and solving problems could have a positive impact on the low-ability students, which could set a good example, supply adequate support, and improve the low-ability students' thinking ability and problem-finding ability.

On the other hand, students' enthusiasm for interaction is different, and high enthusiasm for interaction can make the students raise more questions. One investigation done after the experiment showed that 98.9% of the students preferred to study with the students who had high or similar ability, and the homogeneous group and voluntary group just meet this will of the high- and medium-ability students and that of low-ability students. During the experiment, we observed in the class that medium- and high-ability students in the heterogeneous group had little passion during interaction, which was consistent with the investigation results.

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